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ABSTRACT

This activity guide, developed to provide hands-on environmental education activities geared to New River State Park in North Carolina, is targeted for grades 7 and 8 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: water quality, biotic index, indicator species, metamorphosis, native aquatic species, stewardship of natural resources, watersheds, and natural resource management. Includes a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation, and information about New River State Park. (CCM)

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THE OLD NEW RIVER

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New River State Park

An Environmental Education Learning Experience

Designed for Grades 7 & 8

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THE OLD NEW RIVER

New River State Park

An Environmental Education Learning Experience

Designed for Grades 7 & 8

"The care of the River
is not a question of rivers,
but of the human heart."

- Tanaka Shozo

"We are born of water and
need to be sustained by it."

- Lyall Watson,
The Water Planet,
A Celebration of the Wonder of
Water

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was developed by

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Table of Contents

1. Introduction
- Introduction to the North Carolina State Parks System 1.1
- Introduction to New River State Park 1.2
- Introduction to the Activity Packet for New River State Park 1.6

2. Activity Summary 2.1
- Correlation Chart 2.2

3. Pre-Visit Activities
- #1 Keys to Knowledge 3.1
- #2 Knowing the New 3.2
- #3 Pointing Out Pollution 3.3

4. On-Site Activities
- #1 Life in the Fast Stream 4.1
  - Part I - What's In the Water? 4.1.2
  - Part II - Calculating Water Flow of the New River 4.1.10
- #2 Riparian Ramble 4.2

5. Post-Visit Activities
- #1 Judge and Jury 5.1
- #2 New Development? 5.2
- #3 Reality Check — Rural Development 5.3

6. Vocabulary 6.1

7. References 7.1

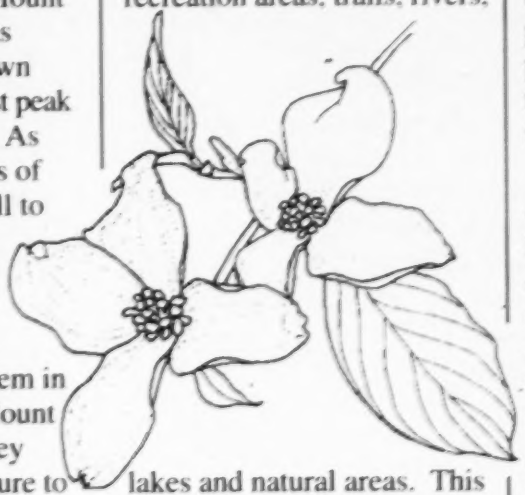
8. Forms 8.1

9. Notes 9.1

Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark — the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first park of North Carolina. That was in 1915.

The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 58 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 147,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181
http://ils.unc.edu/parkproject/ncparks.html

Introduction to New River State Park

The New River is believed to be one of the oldest rivers in North America. Its meandering nature is typical of a river flowing on flat land – before the Appalachians were created. During mountain building about 500 million years ago, the river had enough force to cut down into the earth, following its original course. As several miles of rock have been eroded away since then, the exact location and appearance of the river have changed over time.

The New River begins in the Boone/Blowing Rock area, flowing northward through North Carolina, Virginia and West Virginia. In West Virginia, the New joins the Gauley River to form the Kanawha River. The Kanawha flows into the Ohio River which then flows into the Mississippi River.

The New River is home to some unique animal life. The Kanawha darter, Kanawha minnow and a species of riffle beetle are found only in the New River. The hellbender, an unusually large salamander which can grow to 30 inches in length, is also found in the river. Despite its fierce sounding name, large size, and the folklore that it is poisonous, this creature is harmless. More common animals found in or along the banks include ducks, beavers, turkeys, deer, ospreys, groundhogs, foxes and muskrats.

Numerous species of trees and wildflowers grow along the wooded banks of the river. Occasionally American chestnut sprouts can be found, but white pines, hickory and oaks are the most common trees.

The New River area of northwest North Carolina and southwest Virginia was being used as a hunting ground by Native Americans when the first European settlers arrived in the late 1600s. These early settlers were from Virginia. They established an independent and isolated way of life, farming the mountain valleys. Many of the farms in the area have been in the same family for over 200 years.

In 1962, the Appalachian Power Company applied to the Federal Power Commission to build two dams on the river. The dams would have flooded 42,100 acres in Virginia and North Carolina and would have forced over 2,500 people to move.

This plan was opposed by many of the area's farmers and land owners. Opposition grew into a national movement. Through a long period of nationwide publicity and legal battles, a bill to federally protect the river emerged.

On August 30, 1976 President Ford signed the bill which placed 26.5 miles of the New River into the National Wild and Scenic River System and thus ended the threat of the river being dammed.

The National Wild and Scenic River System was designed to protect the natural and scenic values of free-flowing rivers while providing the opportunity and facilities for public use and enjoyment of those waterways.

The required criteria for Wild and Scenic River designation are that the river must:

- be free flowing;
- be long enough to provide a meaningful recreational experience;
- have a sufficient volume of water to permit full enjoyment of water-related activities;
- have a high water quality to support fish and wildlife.

It must also have one of the following characteristics rated as outstandingly remarkable:

- scenic;
- recreational;
- geologic;
- fish and wildlife;
- historic;
- cultural, or other similar values.

New River State Park protects nearly 1,600 acres along the river, including three park access sites. These sites provide public access to the river, as well as camping, picnicking, fishing and nature study. The Wagoner Road Access is off Highway 88. The U.S. 221 Access is off of Highway 221 North. The Alleghany County Access is accessible only by canoe at this time.

The river has been recognized for its outstanding water quality. Many of the animals that make their home in the river need the high quality water to survive. Development, pesticides and water withdrawal could threaten the river's quality. By being familiar with the causes and effects of water degradation, we can find ways to reduce or eliminate these threats.

The Park as an Outdoor Classroom

New River State Park abounds with natural history and is an excellent place to teach ecology, environmental issues, biology, conservation, earth science, literature, mathematics and recreation. The park is rich in cultural resources and provides a wonderful outdoor classroom for learning about the history of the New River, water quality, endangered species and many other themes. Here, students have an opportunity to explore these and many other subjects through hands-on study.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, nature study and other activities. Leaders may choose to design and conduct their own activities or make use of the park's environmental education activity packets. A park ranger will be happy to meet with your group upon arrival to answer any questions the students may have, or welcome the group and present a short talk. Park staff will make every effort to accommodate persons with disabilities. Please contact the park office at least two weeks in advance to make arrangements for a class visit.

Park Facilities

Picnic Areas

At the Wagoner Road Access area there are two picnic areas with 20 picnic tables. There is also a picnic shelter which may be reserved for a fee. There are 12 tables located at the U.S. 221 Access. There are three picnic tables at the Alleghany County Access; however, this site is accessible only by canoe.

Camping

At the Wagoner Road Access area there are nine primitive sites, located 200 yards down river from the parking lot. There are 12 primitive campsites located at the U.S. 221 Access. The Alleghany County Access has eight canoe-in only campsites.

Playfield

A large open area, suitable for many play activities, is located below the parking area at the Wagoner Road Access area. (No horseshoes; contact a ranger for appropriate activities.)

Restrooms

Restrooms with running water and wheelchair accessibility are available at the park office located at the Wagoner Road Access. They are also available at the 221 Access area. Pit toilets are available at the Alleghany County Access.

Nature Trail

There is a self-guided nature trail at the Wagoner Road Access area. At the 221 and Alleghany Access areas, there are short hiking trails.

Before the Trip

1. To make a reservation, contact the park at least two weeks in advance.

2. Complete the Scheduling Worksheet, located on page 8.1, and return it to the park as soon as possible.

3. Group coordinators should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities and park staff, as well as to identify themes and work out potential problems.

4. Group coordinators should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

5. The group leader is responsible for parental permission forms. An example is located on page 8.2.

6. The group leader should be aware of the group's medical and health needs.

7. *If you will be late or need to cancel your trip, notify the park immediately.*

8. Research Activity Permits may be required for activities in which samples are to be taken from the park. Contact the park to determine if research activity permits are needed.

9. Complete the pre-visit activities in this Environmental Education Learning Experience packet.

While at the Park

1. Complete the on-site activities in this Environmental Education Learning Experience packet.

2. When hiking and studying in New River State Park, please be safety conscious. Some sections of the park's trails are fairly strenuous. Proper footwear should be worn and water should be carried. Also, hazards such as bees, snakes, ticks, poison ivy and extreme weather conditions exist. These hazards can cause problems if you are not prepared. Students with any medical conditions should be monitored closely by the adult leaders.

3. Be as quiet as possible while in the park. This will help you get the most out of the experience, while increasing the chance of observing wildlife.

4. On hikes, walk behind the leader at all times. Running is not permitted. Please stay on the trails!

5. All plants and animals are protected within the park. Injuring or removing plants or animals is prohibited in all state parks. Removal of rocks is also prohibited. This allows future visitors the same opportunity to enjoy our natural resources.

6. Picnic only in the designated picnic areas. Help keep the park clean and natural by not littering and by picking up any trash left behind by others.

7. In case of accidents or emergencies, contact the park staff immediately.

Following the Trip

1. Complete the post-visit activities in this Environmental Education Learning Experience packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered while at the park.

3. Relate the experience to classroom activities through reports, projects, presentations displays, and demonstrations.

4. Give tests or evaluations, if appropriate, to determine if students have gained the desired information from the experience.

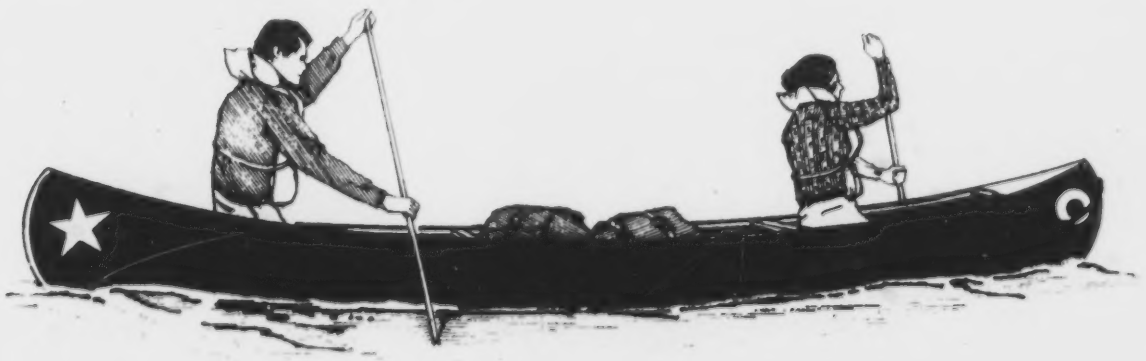
5. Please complete the program evaluation sheet, located on page 8.3, and send it to the park.

Park Information

New River State Park
P.O. Box 48
Jefferson, NC 28640
Tel: 336-982-2587
FAX: 336-982-3943
E-mail: neri@skybest.com

Hours of Operation

Nov. - Feb.	8:00 a.m. - 6:00 p.m.
March, Oct.	8:00 a.m. - 7:00 p.m.
Apr, May,Sept.	8:00 a.m. - 8:00 p.m.
June - Aug.	8:00 a.m. - 9:00 p.m.



Introduction to the Activity Packet for New River State Park

The Environmental Education Learning Experience, *The Old New River,* was developed to provide environmental education through a series of hands-on activities geared to New River State Park. This activity packet, designed for grades 6 - 8, meets established curriculum objectives of the North Carolina Department of Public Instruction. The packet includes three types of activities:

1) pre-visit activities
2) on-site activities
3) post-visit activities

The on-site activities will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom.

The pre-visit activities should be completed prior to the park visit to prepare students for the on-site activities by giving them the necessary introductory background and vocabulary. We encourage you to use the post-visit activities to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. Although these activities may be performed independently, we encourage you to do them in a series to build upon the students' newly gained knowledge and experience.

The Environmental Education Learning Experience *The Old New River* will acquaint students with the following major concepts:

- **Water quality**
- **Biotic index**
- **Indicator species**
- **Metamorphosis**
- **Native aquatic species**
- **Stewardship of natural resources**
- **Watersheds**
- **The New River**
- **River basin**
- **Watershed**
- **Water pollution**
- **Point source pollution**
- **Nonpoint source pollution**
- **Human impact**
- **Land use planning**
- **Rural development**
- **Natural resource management**

The first time a vocabulary word is used in an activity it appears in **bold** type. Its definition is listed in the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary list.

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NOTE: On-site activities, conditions permitting, will be held on the banks of and in the river. Students will be expected to wade in shallow rocky areas. They should dress appropriately (long pants and tennis shoes) and bring a change of clothes. The students may encounter ticks, poison ivy and snakes. This is not likely to happen as long as they stay in appropriate areas.

Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activities

#1 The Keys To Knowledge (page 3.1.1)

Introduce your students to the use of dichotomous identification keys through a series of fun activities. In Part 1, students will use a simple key to identify unknown tree leaves. In Part 2, the students will use a more complex key to identify pictures of macroinvertebrates found in the New River.

Major Concepts:

Part I

- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II

- Basic taxonomy

Learning Skills:

- Observing, classifying and communicating
- Reading informational materials (scientific keys)

Objectives:

Part I

- Define dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

Part II

- Define taxonomy.
- Key out at least one macroinvertebrate using a simple key.

#2 Knowing the New (page 3.2.1)

This activity is designed to develop an awareness of the location and land area of the New River Basin. Using maps and a worksheet, students will study the path of the New River and its tributaries, measure distances between different points on the river, and trace the river from its headwaters to the ocean.

Major Concepts:

- The New River
- River basin
- Watershed

Learning Skills:

- Observing, communicating, and inferring
- Reading and interpreting maps
- Estimating distances
- Creative writing

Objectives:

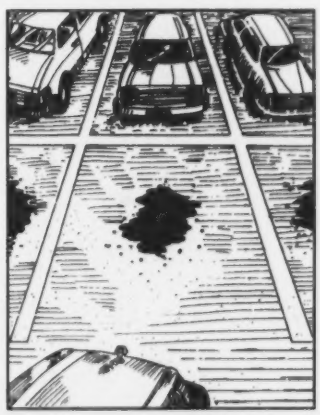
- Locate the New River on a map and identify the states through which it flows.
- Using a ruler, string, and a map scale, calculate straight-line distances and river miles on a map.
- Trace, on a map, the movement of a drop of water from a point on the New River to the Gulf of Mexico. Identify major river basins and states that the water drop would pass through.
- Write a story about an imaginary journey down the New River to the Gulf of Mexico.

#3 Pointing Out Pollution (page 3.3.1)

This activity is designed to help students define water pollution, understand the difference between point and nonpoint source pollution, and identify on a topo map some potential sources of water pollution. Additionally, it will help them understand the concept of watersheds and become familiar with the New River Basin in North Carolina.

Major concepts:

- Watershed
- Water pollution
- Point source pollution
- Nonpoint source pollution



Learning Skills:

- Communicating, classifying, inferring, predicting
- Applying and expanding on information
- Group participation, map reading
- Problem-solving, measuring

Objectives:

- Define water pollution.
- Describe the difference between point and nonpoint source pollution.
- Using a legend, correctly locate specific features on a topo map such as rivers, towns, and the boundaries of a watershed.
- Draw inferences about human activities from a topo map and predict possible effects on specific watersheds.

II. On-Site Activities

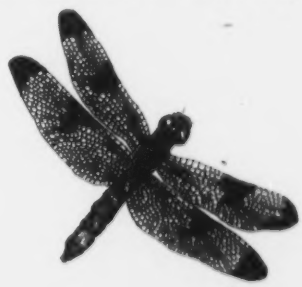
#1 Life in the Fast Stream (page 4.1.1)

Get wet, have fun, and learn while doing it. In Part 1, "What's In the Water?" students will use different methods to collect and identify aquatic organisms. In Part 2, "Calculating Water Flow of the New River," students will learn a simple method for determining water flow and use this information to explore the ways that human and natural factors affect water flow and water quality. They will also be asked to think of ways they can influence local government to protect water quality.

Major Concepts:

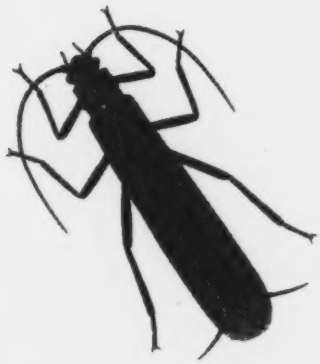
Part I

- Water quality
- Aquatic sampling
- Indicator species
- Aquatic habitats



- Species identification
- Biotic index
- Human influence on water quality

Part II
- Water flow
- Human influences on water flow and aquatic life
- Natural influences on water flow and aquatic life
- Water quality
- Stewardship



Learning Skills
- Observing, classifying, and communicating
- Interpreting data and making inferences
- Calculating water velocity

Objectives

Part I
- Describe three characteristics of an aquatic macroinvertebrate.
- Key out five macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- List three or more ways humans affect aquatic life.

Part II
- Calculate the rate of water flow.
- List three human actions and three natural influences on water flow.
- Explain the relationship between water quantity and quality.
- Describe three problems that can result from water quantity extremes and three from water quality changes.
- Discuss two ways people can help protect rivers and water quality.

#2 Riparian Ramble (page 4.2.1)

In this activity, educators will guide students along the New River Nature Trail, a one-mile loop trail that goes through the woods and along the banks of the New River. The purpose of the hike is to provide students with a series of hands-on activities that will help them appreciate the natural and cultural history of the area.

Major Concepts:
- Water quality
- Watershed
- Stewardship

Learning Skills:
- Observing, communicating, inferring
- Collecting, analyzing and evaluating information
- Map reading

Objectives:

- Make field observations and inferences regarding past land use along the New River.
- Compare Native American use of the New River Basin with that of the European settlers.
- Use a topographic map to find elevation and flood levels in the field.
- Explain the designation "wild and scenic river" and how it relates to development in the watershed today.

III. Post-Visit Activities

#1 Judge and Jury (page 5.1.1)

In this role play activity, the students will learn about land use conflicts and stewardship.

Major concepts:

- Stewardship
- Cultural conflicts
- Land use changes

Learning Skills:

- Communicating, inferring, predicting
- Organizing and analyzing information
- Participating effectively in creative interpretation

Objectives:

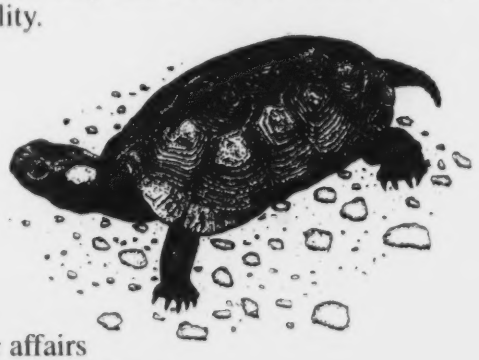
- Present rational points in a debate over land use.
- List three reasons for preserving and protecting the river corridor.
- List three reasons for developing all or part of the river corridor.

#2 New Development? (page 5.2.1)

The purpose of this activity is to encourage students to wrestle with development, local economy, and stewardship of natural resources. The students will use the South Fork — New River watershed as a microcosm of environmental concerns in making management decisions. They will arrange conflicting land uses on a watershed map and attempt to balance economic development with the need to protect water quality.

Major concepts:

- River basin
- Water quality
- Land use planning
- Resource management
- Stewardship



Learning Skills:

- Observing, predicting, communicating
- Decision-making, participating effectively in civic affairs
- Responding critically and creatively to environmental problems

Objectives:

- Name two species in the New River Basin that are listed as endangered, threatened or special concern.
- Define endemic and list one example of an endemic species in the New River Basin.
- Predict positive and negative effects of at least five potential land uses on the South Fork — New River watershed.
- Balance the need to protect water quality with economic and other concerns while working with a group to arrange land use cutouts on a watershed map.
- Describe at least three ways that individuals can contribute to improving water quality in their watershed or river basin.

#3 Reality Check — Rural Development (page 5.3.1)

This activity gives students the opportunity to study an actual development project currently underway along the shores of the New River near the state park. In Part I, the students analyze a news article to find the "players" and their differing values and beliefs regarding the development. In Part II, students gather facts and opinions about this issue and generate solutions.

Major concepts:

- Environmental issues
- Water quality
- Land use planning
- River basin management
- Stewardship

Learning Skills:

- Observing, communicating, inferring, predicting
- Problem-solving, participating effectively in civic affairs
- Assessing the validity and accuracy of ideas

Objectives:

- Analyze a news article about a land use issue in the New River Basin. Distinguish between facts and opinions, and make inferences regarding the beliefs and values of the individuals and groups interviewed by the reporter.
- Collect and organize facts and opinons about a current environmental issue by using interviews, surveys, questionnaires and opinionnaires.
- Work in groups to develop solutions to a current environmental issue. The solutions should be based on the facts the students have gathered and should represent a win-win approach for the major interest groups they have identified.

Correlation Chart

Note to classroom teachers: The following Correlation Chart shows how each activity in this Environmental Education Learning Experience (EELE) correlates with the North Carolina Department of Public Instruction (DPI) objectives in science, mathematics, social studies and English language arts. The activities are listed in the order in which they appear in this EELE. The recommended grade levels are listed along the side of the chart. Notice that only the objective numbers are listed. Use your DPI Teacher Handbook for each subject area to get a complete description of the objectives in that subject area.

Pre-Visit Activity #1: The Keys to Knowledge, p. 3.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	2.1, 2.2, 2.3, 2.5, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1		
7	2.1, 2.2, 2.3, 2.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1		
8	2.1, 2.2, 2.3, 2.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1		

Pre-Visit Activity #2: Knowing the New, p. 3.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	2.1, 2.3, 2.4, 2.5, 2.6, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	3.1, 3.2, 4.2 Skill Goal I	4.1, 4.2
7	2.1, 2.3, 2.4, 2.5, 2.6, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	3.1, 3.2, 4.2 Skill Goal I	4.1, 4.2, 5.2
8	2.1, 2.3, 2.4, 2.5, 2.6, 4.2, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	1.1, 1.2, 1.3 Skill Goal I	4.1, 5.2

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Correlation Chart

Pre-Visit Activity #3: Pointing Out Pollution, p. 3.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3,		4.1, 4.3, 5.1, 5.2
7	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3,		4.1, 4.2, 5.1, 5.2, 5.3
8	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3,	1.1, 1.2, 1.3, 11.2, Skill Goals I, II & IV	4.1, 4.3, 5.1, 5.2

On-Site Activity #1: Life in the Fast Stream, p. 4.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 5.1, 6.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3		4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 5.1, 5.2, 5.3, 5.4, 5.5, 6.2, 6.5, 6.6, 6.7
7	2.1, 2.2, 2.3, 2,4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3		4.1, 4.2, 4.3, 4.6, 5.1, 5.2, 5.3, 5.4, 5.5, 7.2, 7.3
8	2.1, 2.2, 2.3, 2,4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 5.1, 6.6, 6.7	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3		4.1, 4.2, 4.3, 4.5, 5.1, 5.2, 5.3, 5.4, 5.5

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Correlation Chart

On-Site Activity #2: Riparian Ramble, p. 4.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2		
7	2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2		
8	2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 6.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 11.2, 11.3 Skill Goals I & II	

Post-Visit Activity #1: Judge and Jury, p. 5.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	1.1, 2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
7	1.1, 2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
8	1.1, 2.1, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	1.3, 8.2, 11.2 Skill Goals I, II, III & IV	

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Correlation Chart

Post-Visit Activity #2: New Development?, p. 5.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	1.1, 2.1, 2.3, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
7	1.1, 2.1, 2.3, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
8	1.1, 2.1, 2.3, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 5.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 1.5, 8.2, 11.2 Skill Goals I, II, III, & IV	

Post-Visit Activity #3: Reality Check — Development on the New, p. 5.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
6	1.1, 1.4, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 4.3, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
7	1.1, 1.4, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 4.3, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		
8	1.1, 1.4, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 4.3, 5.1, 5.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 1.5, 11.2 Skill Goals I, II, III, & IV	

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Pre-Visit Activity #1 — The Keys To Knowledge

Curriculum Objectives:
Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: being responsible in a group, develop an awareness of alternative points of view
- Science: scope of life science, organization and variety of living things, plant and animal communities
- Social Studies: evaluate, organize and analyze information, draw conclusions

Grade 8
- Communications Skills: listening, viewing, reading and vocabulary comprehension, study skills using environmental sources
- Science: adaptation, ecology
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
Part I: 20 - 30 minutes
Part II: 30 - 50 minutes

Appropriate Season: Any

Materials:
Provided by educator:
Per student: "Key it Out" worksheet, "Key to 10 Common Leaves," pencil
Per group: "Key to Aquatic Macroinvertebrates of the New River," "Aquatic Life" illustrations, ruler

Major Concepts:
Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II
- Basic taxonomy

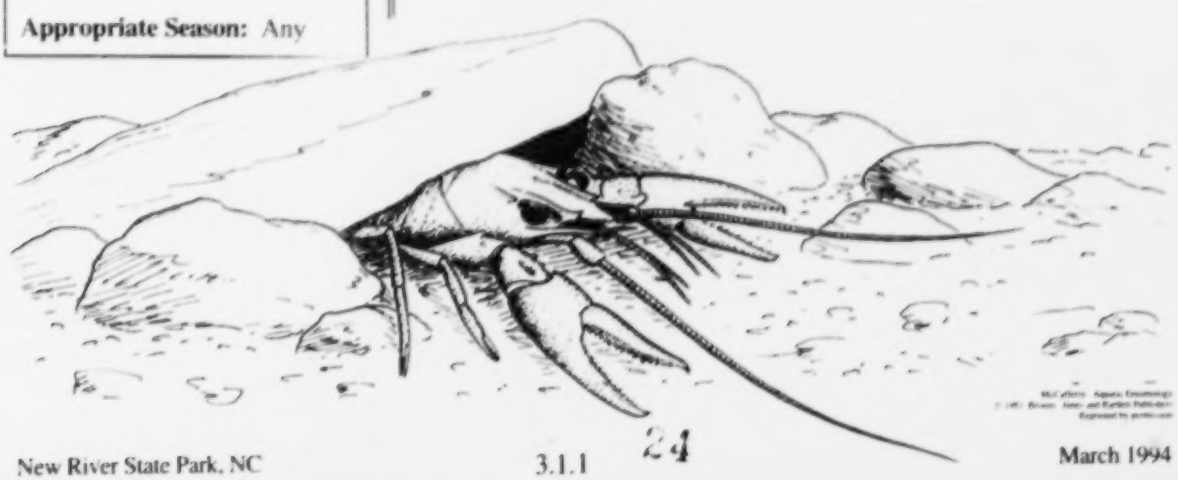
Objectives:
Part I
- Define a dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

Part II
- Define taxonomy.
- Key out at least one macroinvertebrate using a simple key.

Educator's Information

The purpose of this two-part activity is to introduce the use of a simple dichotomous identification key. Students will learn what a dichotomous key is, why keys are useful and how to use a simple identification key.

Part I will give students an introduction to the use of a simple tree identification key. In Part II, the students will key out several macroinvertebrates using the same key they will use in the on-site activity "Life in the Fast Stream."



Instructions for Part I:

Have the students read the Student's Information. Discuss taxonomy and how organisms are divided into naturally related groups. Define a key and explain how keys work. Discuss why keys are useful. Give each student a copy of the "Key to 10 Common Leaves." Have students work independently through this key to identify each of the 10 leaves. As a class, go over the answers and discuss any difficulties encountered.

Instructions for Part II:

Divide the class into groups of four or five. Give each group a copy of the "**Aquatic** Life" illustrations and a copy of "Key To Common **Macroinvertebrates** of the New River." As a class, work through the key to identify animal number 1, then have the students work within their groups to identify the rest of the macroinvertebrates. When the groups are finished, have each group share how they identified one of their macroinvertebrates. Discuss any difficulties encountered and reinforce the importance of keys.

Suggested Extensions:

1. Divide the class into six groups and give each group a picture of a macroinvertebrate. Instruct each group to identify their organism. Have each group share with the class how the organism was identified.

2. Have the students do the Aquatic Project WILD activity "Are You Me?" For more information, contact the park staff.

3. Have students create macroinvertebrate "flash cards" from the Aquatic WILD activity "Are You Me?" to learn identification.

Student's Information

To understand why **keys** are necessary, we need to know some basics about **taxonomy**. Taxonomy is the branch of **biology** that deals with the **classification** of **organisms** into established categories. The word taxonomy comes from the Greek words mean-ing "arrangement" and "law". Through taxonomy, organ-isms are arranged into related groups based on similarities in **morphology**, **anatomy**, **physiology**, genetics, **ecology** and **distribution**.

All organisms are grouped into large groups known as kingdoms. There are five major kingdoms:

1) Animalia (mammals, **insects**, birds, reptiles, etc.);
2) Plantae (plants);
3) Fungi (mushrooms, molds, yeasts, etc.);
4) Protista (some **algae** and protozoans); and
5) Monera (bacteria and blue-green algae).

These kingdoms are further divided into more closely related groups down to a specific organism.

For example, let's trace the taxonomic classifications of a dragonfly. Dragonflies belong to the kingdom Animalia. From here they are divided into the phylum Arthropoda, which contains all insects and their relatives. Next, they are placed in the class entitled Insecta. In North America alone, there are 88,600 species of insects. The class Insecta is further divided into groups called orders. In North America, there are 27 orders, each order containing closely related insects. Dragonflies are in the order Odonata. They are further divided up into families, then **genus** and finally **species**. Worldwide there are about 4,500 species of dragonflies, while in North Carolina there are only 186 species. To discover what species we have in North Carolina, we would use an identification key.

Keys:

A key is an essential tool used by people studying the science of taxonomy. It is defined as "an ordered list of significant characteristics of a group of organisms used to identify unknown organisms." Simply put, a key is a list of characteristics that describe an organism. Keys are used by scientists and students to identify unknown organisms. Keys often use a combination of pictures and written descriptions to aid in identification. Once you know the name of an organism, then you can look up information about it.

Dichotomous Keys:

Most keys are **dichotomous**, which means dividing or branching into two parts. A dichotomous key, therefore, is a key that divides the characteristics that describe an organism into two choices. At each level of the key, you pick the choice that best describes the organism you are trying to identify.

How a Key Works:

Here's how a dichotomous key works. A list of characteristics arranged as a series of either/or statements is used for identifying plants and animals. For each pair of statements, choose the one that best describes the item you're identifying. For example, if you were handed a leaf from a pine tree to identify, you would start at the top of the tree identification key with these two choices:

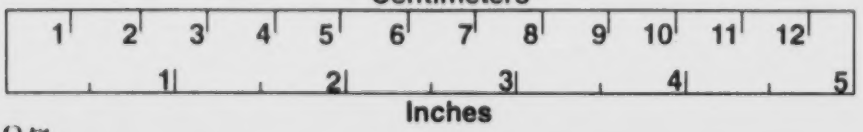
1. Leaves not long or needle-like.
2. Leaves long and needle-like.

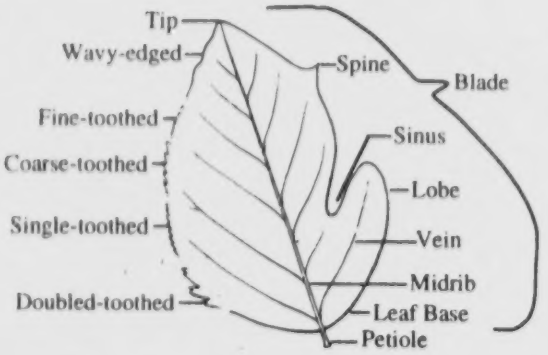
Of course, a pine leaf (or needle) is long and needle-like so you would choose option number 2 and continue to the next choice under that side of the dichotomous key.

Key to 10 Common Leaves

(Tree Leaves)

- Leaf long & needle-like
  - Leaves in groups of 2; less than 7 cm long — *Virginia pine*
  - Leaves in groups of 5; more than 7 cm long — *White pine*
- Leaf not needle-like
  - Leaf with lobes
    - Edge of leaf without teeth
      - Petiole of leaf 1 cm or longer
        - Leaf petiole less than 2 cm — *Sassafras*
        - Leaf petiole longer than 2 cm — *Tulip poplar*
      - Petiole of leaf less than 1 cm — *White oak*
    - Edge of leaf with teeth
      - Leaf with 5 lobes; petiole 3.5 cm or longer — *Sweet gum*
      - Leaf with 3 lobes; petiole shorter than 3.5 cm — *Red maple*
  - Leaf without lobes
    - Leaf edge with teeth
      - Each tooth with spine — *American holly*
      - Teeth without spines — *River birch*
    - Leaf without teeth — *Catawba rhododendron*



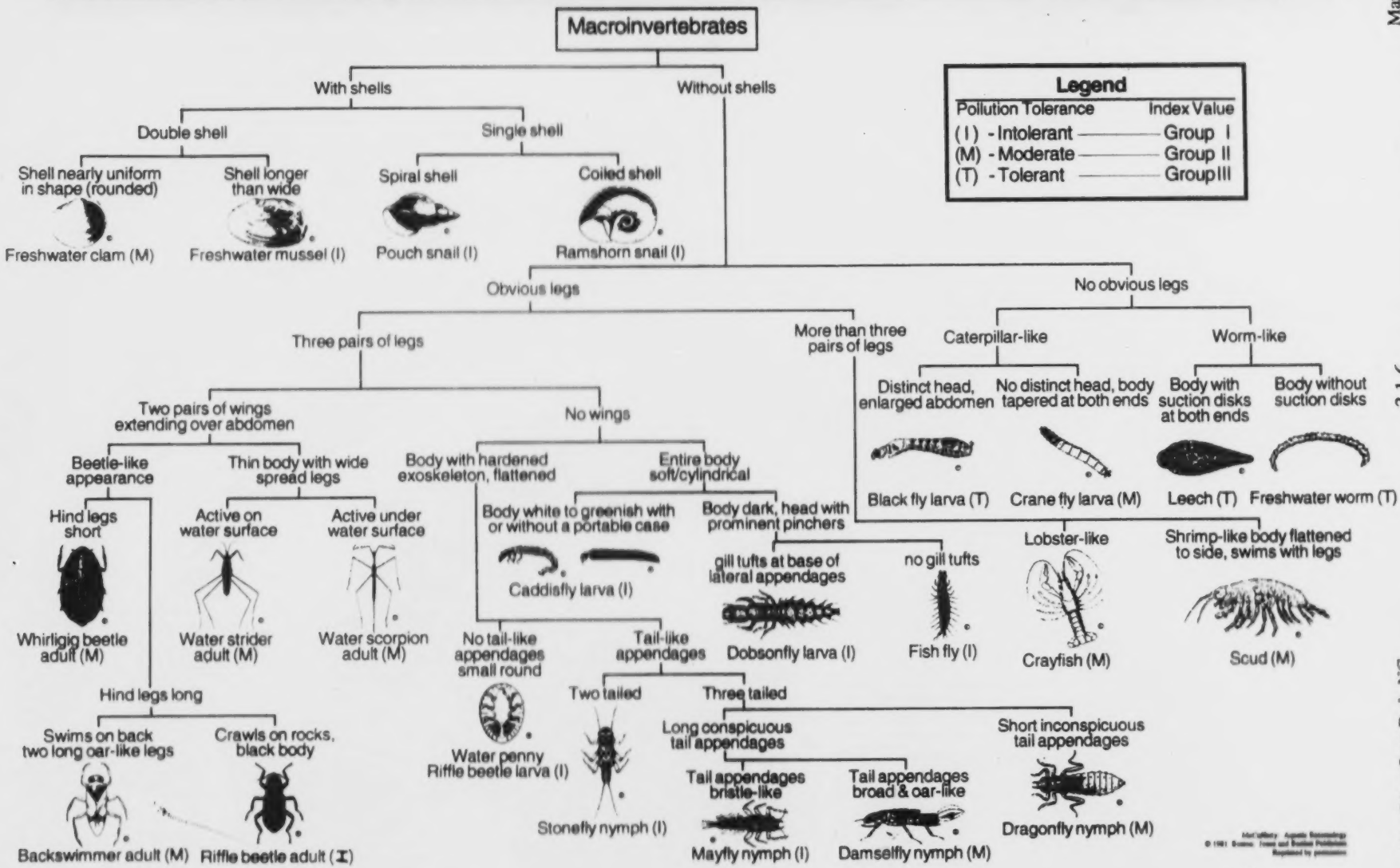


March 1994

3.1.4

New River State Park, NC

Key To Aquatic Macroinvertebrates
of the New River



March 1994

3.1.6

New River State Park, NC

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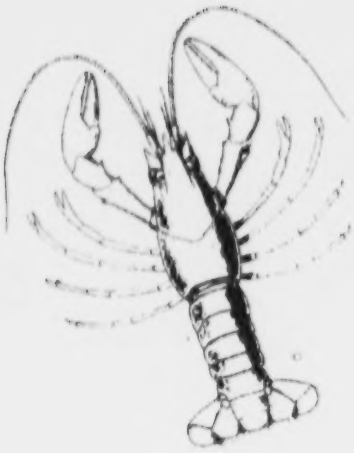
10 Common Leaves

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

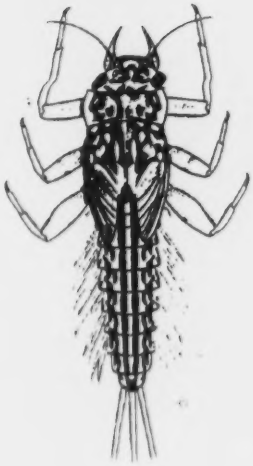
Aquatic Life Illustrations

1. _____



2. _____

3. _____



4. _____

5. _____

6. _____

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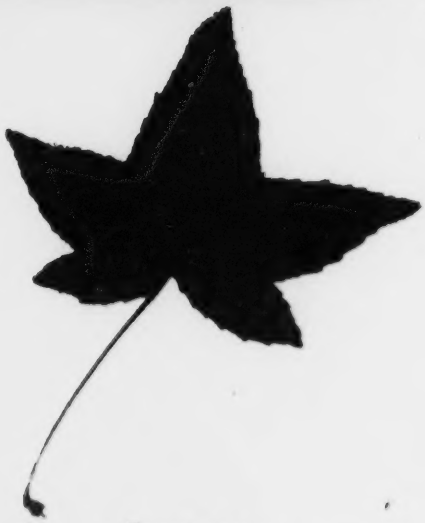
Answer Sheet to 10 Common Leaves

1. *Catawba rhododendron*

2. *Sassafras*



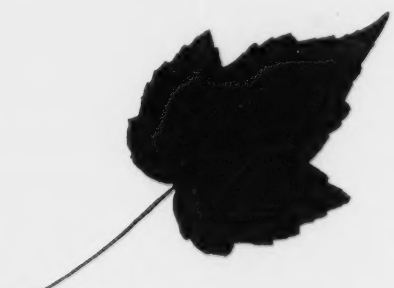
3. *Sweet gum*

4. *White oak*

5. *Tulip poplar*

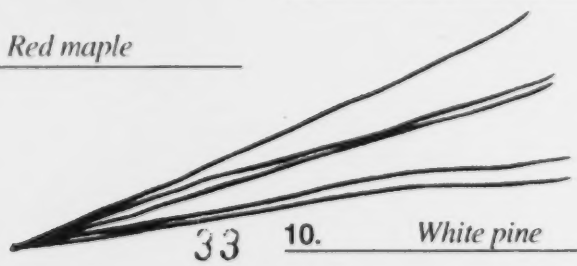
6. *River birch*

7. *American holly*



8. *Red maple*

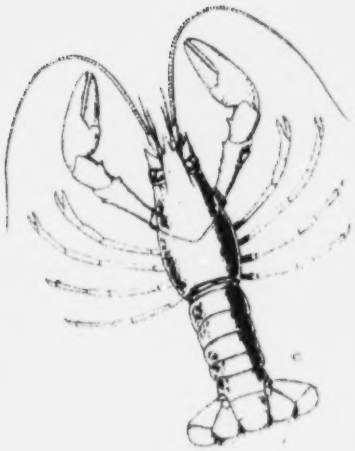
9. *Virginia pine*



10. *White pine*

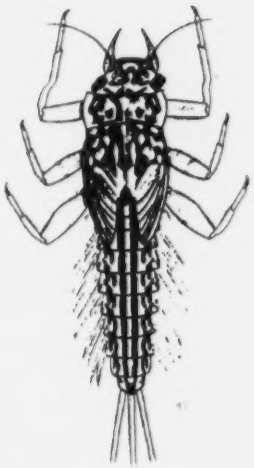
Answer Sheet to Aquatic Life Illustrations

1. *whirligig beetle*

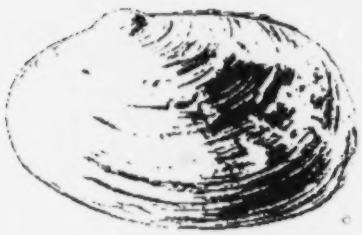


2. *crayfish*

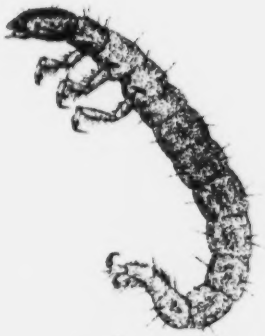
3. *water penny*



4. *mayfly nymph*



5. *freshwater mussel*



6. *caddisfly larva*

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Pre-Visit Activity #2 — Knowing the New

Major Concepts:
- The New River
- River basin
- Watershed

Learning Skills:
- Observing, communicating, and inferring
- Reading and interpreting maps
- Estimating distances
- Creative writing

Subject Areas:
- Mathematics
- Science
- Social Studies
- English Language Arts
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 30 students

Estimated Time:
60 minutes or longer

Appropriate Season: Any

Materials:
Provided by the educator:
Per group:
New River Map, New River to the Gulf of Mexico map, Knowing the New– Worksheet, North Carolina River Basins map, ruler, string, pencil, tape
Per student:
one copy of the Student's Information
Per class:
(optional) highway maps and/or topographic maps that contain the New River watershed, highway map of the southeastern United States

Objectives:

- Locate the New River on a map and identify the states through which it flows.
- Using a ruler, string, and a map scale, calculate straight-line distances and river miles on a map.
- Trace, on a map, the movement of a drop of water from a point on the New River to the Gulf of Mexico. Identify major river basins and states that the water drop would pass through.
- Write a story about an imaginary journey down the New River to the Gulf of Mexico.

Educator's Information:

This activity is designed to develop an awareness of the location and land area of the New **River Basin**. Using maps and a worksheet, students will study the path of the New River and its **tributaries**, measure distances between different points on the river, and trace the river from its headwaters to the ocean. If the educator has access to **topographic** maps or highway maps for the New River Basin and for the southeastern United States, display these in the classroom so that students can compare their photocopied maps to more detailed maps.

Instructions:

1. Photocopy the three map sections and worksheet for each team of two to three students. If desired, photocopy the Student's Information for each student. Read and/or discuss the Student's Information with the class, making certain they understand that the New River flows in a northerly direction.

2. Divide the class into groups of two or three. Pass out the two sheets that represent the New River Basin and the tape. Have the teams tape these sheets together to create the New River Map. Pass out the Knowing the New– Worksheet, New River to the Gulf of Mexico map, rulers and string. Explain that the students will use the New River Map to answer questions 1 - 12. When teams reach question 13, they should use the smaller map, New River to the Gulf of Mexico.

3. Demonstrate how to estimate "river miles" by using a piece of string and a ruler. Lay the string on the winding course of the river, then straighten and measure the length of the string with a ruler. Use the map scale to convert inches of string to the actual distance in river miles.

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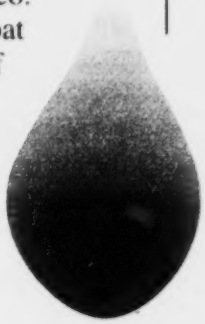
4. When students have completed the worksheets, check their answers.

5. Using the North Carolina River Basins map as their guide, students should discuss how the New River differs from other rivers in North Carolina. Which rivers in North Carolina flow directly into the Atlantic Ocean? Which ones flow into another river before reaching the Atlantic? Which ones are a part of the Mississippi River Basin and ultimately empty into the Gulf of Mexico? Or, compare the New River to rivers in other countries that the students are currently studying in Social Studies.

6. Ask students to write a story about an imaginary journey as a member of John Salley's crew, or a water drop, or another object or person, traveling from New River State Park to the Gulf of Mexico. Did they use a boat or other means of transportation? What was their favorite part of the water journey and why?



Assessment:

1. Using a map of the United States, ask students to locate the New River and trace it as it joins other rivers and flows into the Gulf of Mexico. Note: Do not allow students to refer to the simplified maps in this activity.

2. Have students use other maps with scales to determine river miles versus straight-line distances between two distinct points on a river.

3. Encourage students to share their stories of their imaginary journeys down the New River. Create a chain story where one student or team of students begins the story at Blowing Rock and other students continue the journey until it finally ends at the Gulf of Mexico.

Extensions:

1. If the educator has access to topographic maps for the New River area, the students can try to determine the boundaries of the New River **watershed**, also called a river basin. If your map(s) are laminated, students can use water-based markers to outline the river basin. Follow tributaries, **contour lines** and ridge lines to determine where the river basin ends. Once the basin is outlined, students can see which towns, factories, landfills, etc. are contained in the New River watershed. Help the students to visualize the hydrology of the river basin. For example, if my house or my school exists within the boundaries of the river basin, whenever I flush the toilet, the water eventually ends up in the New River. Examine the map for symbols of buildings, roads, schools, mines, and other human-made structures that lie within the river basin.

2. Use the Internet (if possible) to contact other schools in the New River Basin and beyond. Share experiences about the river from fishing to canoeing to river clean-ups.

Student's Information

The New River, despite its name, may actually be one of the oldest rivers in North America. Geologists do not know the exact age of the New River, but they have some guesses. If you look at a map of the New River, you can observe it has many horseshoe bends and loops, called **meanders**. Meanders usually form gradually over hundreds of years as a river flows through flat land. However, the New River does not flow through flat land today. Therefore, geologists infer that the New River must have developed before the land was uplifted to create the mountains and hills around it. When the mountains began forming about 500 million years ago, the New River was able to cut through the land and maintain its original course. Thus, geologists speculate the river is at least 500 million years old and could be even older.

Originating in the North Carolina mountains, this ancient waterway winds its 250-mile route north and west through North Carolina, Virginia, and West Virginia. In the early history of this country, some people thought that the New River might be a route to the Pacific Ocean. John Salley dispelled this notion in 1752 when he and his companions took a wet and wild journey down the New in a buffalo-skin boat. They bobbed their way down the rapids through Virginia into West Virginia, where the New joins the Gauley River to form the Kanawha River. They continued their travels down the Kanawha into the Ohio River. After seven weeks, they finally reached the Mississippi River where they were promptly captured by the French and Shawnee! If they had been allowed to continue their trip, they would have eventually reached the Gulf of Mexico. The complete journey, from the headwaters of the New River to the Gulf of Mexico, is about 2,000 miles and takes about 110 days, at a river flow speed between 3.5 and 7 miles per hour.

The New River has been used by people for many years. The Native Americans, who used it as a hunting ground, called it Kanawha and Mondongachete. Early European explorers called it simply the Great River, and

later, Wood's River, after the sponsor of an excursion to find it. The section of the New River that runs through northwestern North Carolina and southwestern Virginia was settled by Europeans in the late 1600s. Farming the mountain valleys, they established an independent and isolated way of life. Many farms in the area have been in the same family for more than 200 years. Today, canoeists, fishermen, hikers, and nature lovers also use the river. Its beautiful scenery and reputation as a great fishing river make it an important recreational resource.

All the land that drains into the New River is part of its **watershed** or **river basin**. Any activities that occur in one part of the river basin will eventually affect the river. Think of it this way — if you live in the New River Basin, whenever you flush your toilet, the water will eventually end up in the New River. As you follow the course of the New River on a map, you will see that it drains into other, larger river basins. You may be amazed to discover that the New River Basin is just a tiny piece of the giant Mississippi River Basin. Whatever happens in the New River in North Carolina potentially affects everyone downstream in eleven other states!

Knowing the New — Worksheet

Student Names: _____

1. Through how many states does the New River flow? _____
Name the states: _____

2. How many lakes are on the New River? _____ What are their names and in what states are they found?

_____

3. How many state parks border the New River? _____ Why do you think there are so many? _____

_____

4. Near what town does the New River end? _____

5. Near what town does the New River begin? _____

6. What are the names of the two forks of the New River? _____

7. What is the approximate length in river miles of the South Fork of the New River in North Carolina? _____

8. What is the approximate length in river miles of the New River from I-77 near Shot Tower to Claytor Lake? _____

9. Approximately how many miles is it between Blacksburg and Hinton in a straight line? _____ Following the New River (in river miles)? Hint: Start at the bend in the river closest to Blacksburg. _____

10. What interstate highways cross the New River? _____

11. Near what town, and in what state, does the New River become the Kanawha River? _____

12. Galax, Virginia is located in what compass direction of Boone, North Carolina?

_____

Knowing the New — Worksheet (page 2)

13. Using the map, New River to the Gulf of Mexico, identify all of the rivers that would carry a drop of water from the New River's headwaters to the Gulf of Mexico.

_____

14. Near what city and in what state does the Ohio River enter the Mississippi River?

_____

15. At what city does the Kanawha River flow into the Ohio River? _____

16. How many states would a drop of water pass through on its journey from Blowing Rock, NC to the Gulf of Mexico?_____

Name the states: _____

_____

Knowing the New — Worksheet (Answers)

Student Names: _____

1. Through how many states does the New River flow? Three
Name the states: *North Carolina, Virginia, and West Virginia*

2. How many lakes are on the New River? Two What are their names and in what states are they found?
Claytor Lake in Virginia and Bluestone Lake in West Virginia

3. How many state parks border the New River? Six Why do you think there are so many? *The state parks are there to protect the resource*

4. Near what town does the New River end? *Gauley Bridge, West Virginia*

5. Near what town does the New River begin? *Blowing Rock or Boone, North Carolina*

6. What are the names of the two forks of the New River? *South Fork and North Fork*

7. What is the approximate length in river miles of the South Fork of the New River in North Carolina? *90 miles*

8. What is the approximate length in river miles of the New River from I-77 near Shot Tower to Claytor Lake? *30 miles*

9. Approximately how many miles is it between Blacksburg and Hinton in a straight line? *45 miles* Following the New River(in river miles)? Hint: Start at the bend in the river closest to Blacksburg. *80 miles*

10. What interstate highways cross the New River? *I-77, I-64, I-81*

11. Near what town, and in what state, does the New River become the Kanawha River? *Gauley Bridge, West Virginia*

12. Galax, Virginia is located in what compass direction of Boone, North Carolina?
Northeast

Knowing the New — Worksheet (Answers - page 2)

13. Using the map, New River to the Gulf of Mexico, identify all of the rivers that would carry a drop of water from the New River's headwaters to the Gulf of Mexico.

New River, Kanawha River, Ohio River, Mississippi River

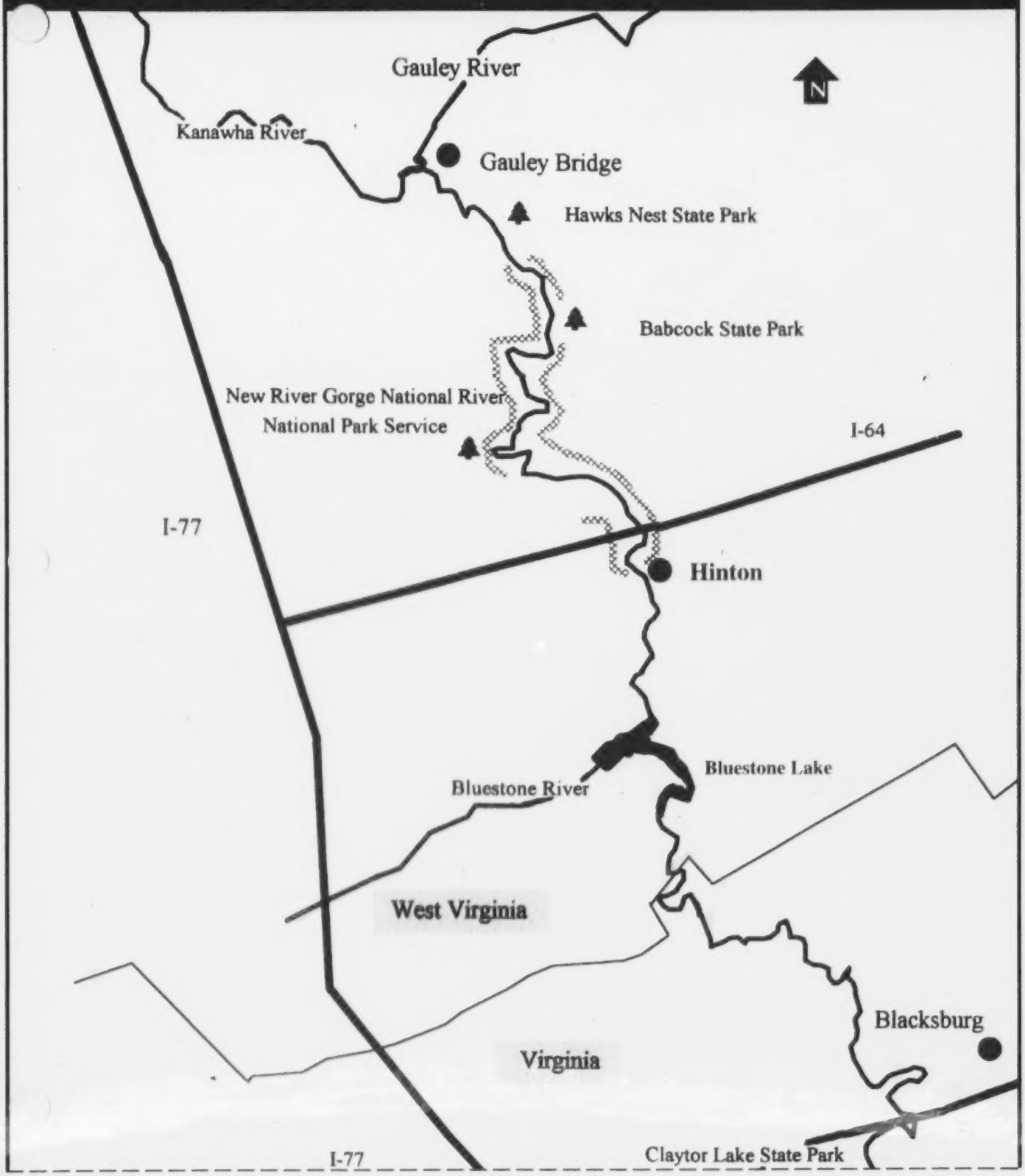
14. Near what city and in what state does the Ohio River enter the Mississippi River?
Cairo, Illinois

15. At what city does the Kanawha River flow into the Ohio River? *Point Pleasant, WVA*

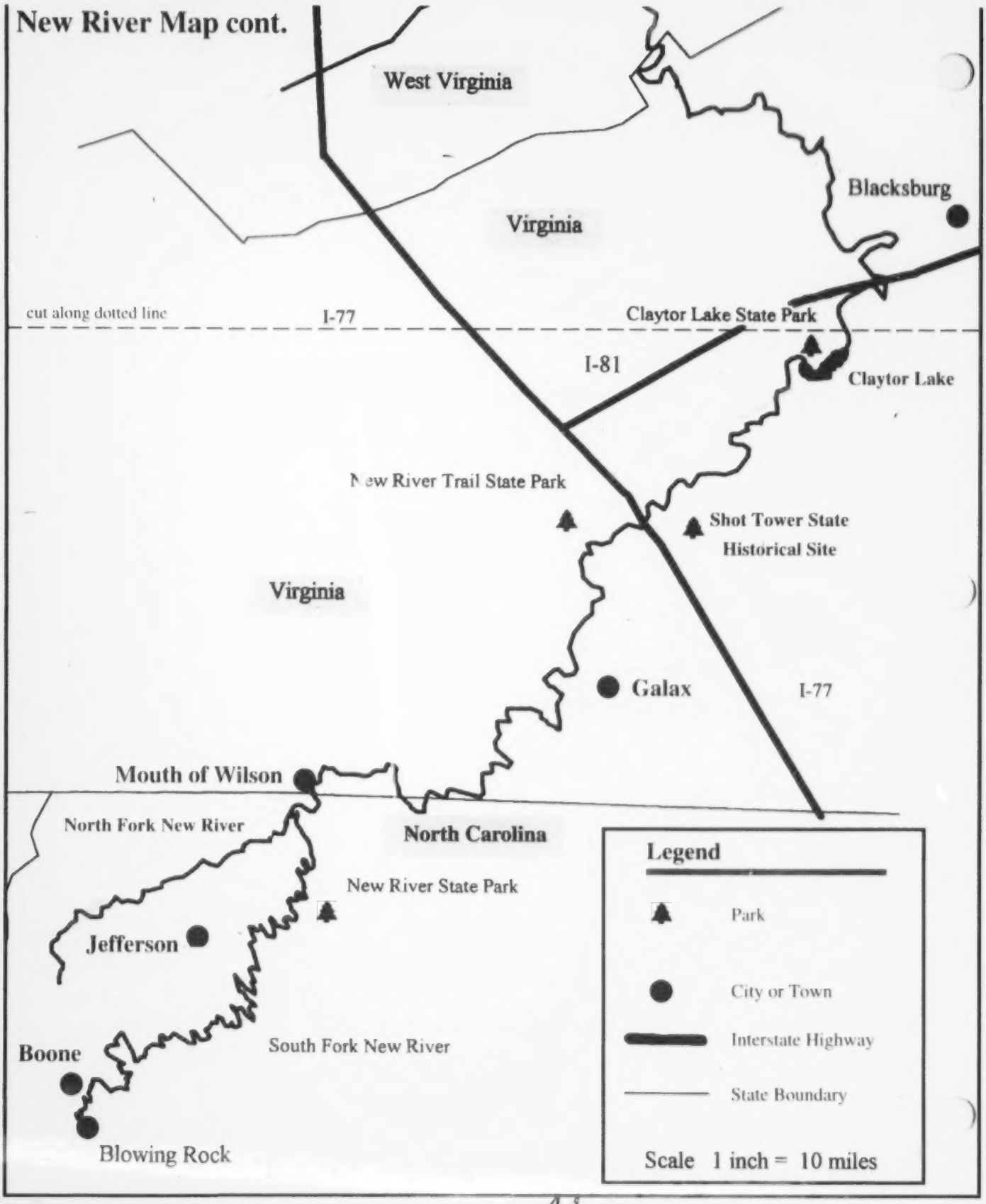
16. How many states would a drop of water pass through on its journey from Blowing Rock, NC to the Gulf of Mexico? 12 states

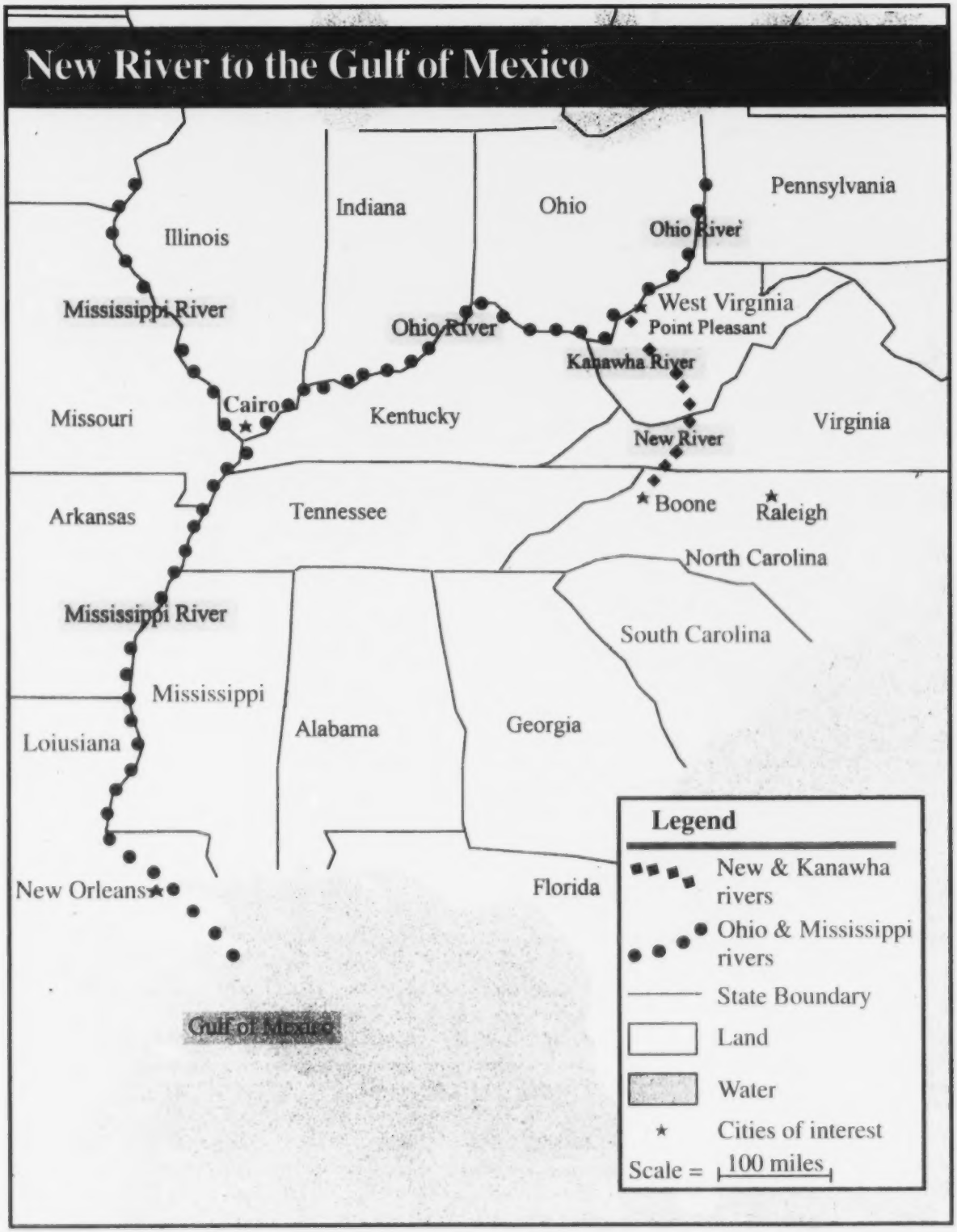
Name the states: *North Carolina, Virginia, West Virginia, Ohio, Kentucky, Indiana, Illinois, Missouri, Tennessee, Arkansas, Mississippi, and Louisiana*

New River Map

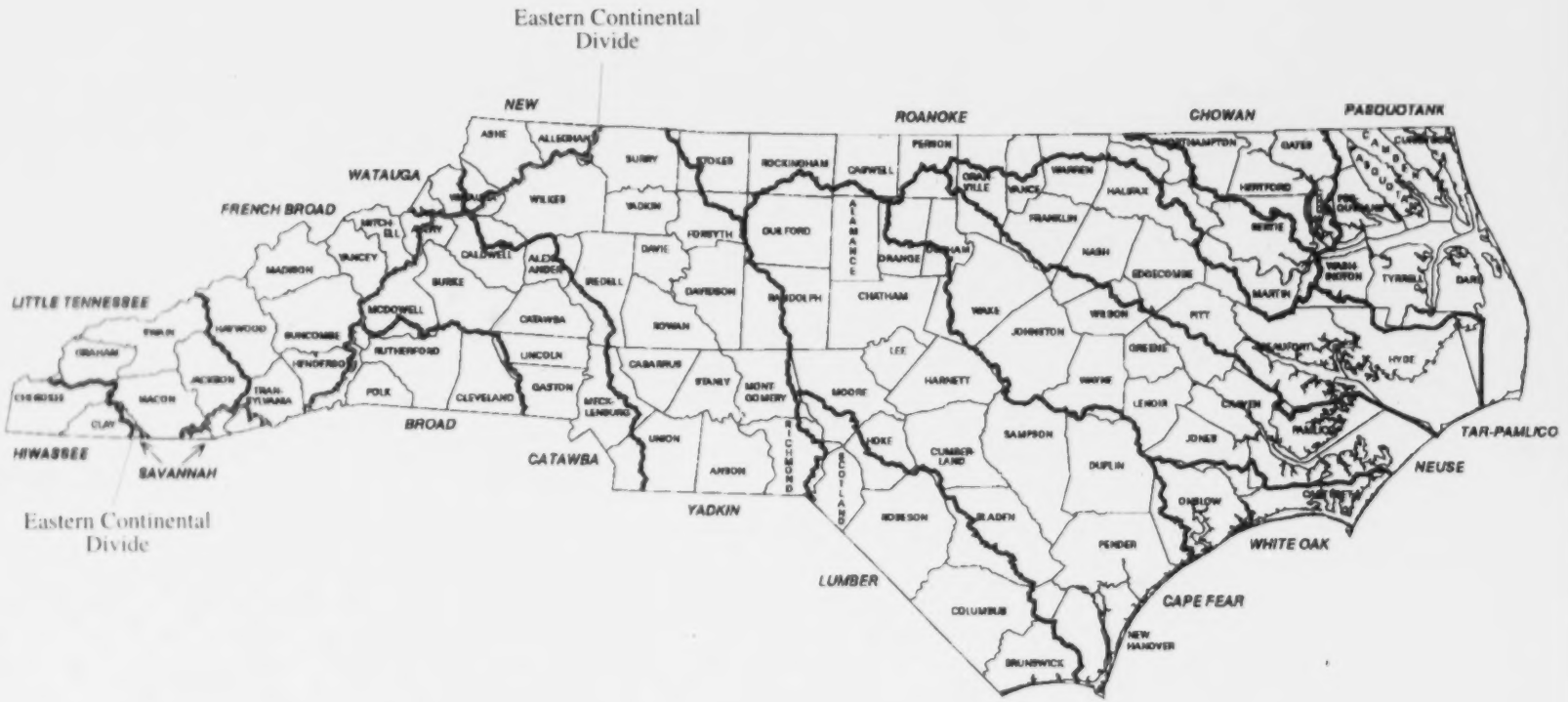


cut along dotted line


New River Map cont.
West Virginia
Virginia
Blacksburg
cut along dotted line
I-77
Claytor Lake State Park
I-81
Claytor Lake
New River Trail State Park
Shot Tower State
Historical Site
Virginia
Galax
I-77
Mouth of Wilson
North Fork New River
North Carolina
New River State Park
Jefferson
Boone
South Fork New River
Blowing Rock
Legend
Park
City or Town
Interstate Highway
State Boundary
Scale 1 inch = 10 miles


New River to the Gulf of Mexico
Illinois
Indiana
Ohio
Pennsylvania
Ohio River
Mississippi River
West Virginia
Point Pleasant
Ohio River
Kanawha River
Cairo
Missouri
Kentucky
Virginia
New River
Arkansas
Tennessee
Boone
Raleigh
North Carolina
Mississippi River
South Carolina
Mississippi
Alabama
Georgia
Loiusiana
New Orleans
Florida
Gulf of Mexico
Legend
New & Kanawha rivers
Ohio & Mississippi rivers
State Boundary
Land
Water
Cities of interest
Scale = 100 miles

North Carolina River Basins



Office of Environmental Education
N.C. Department of Environment and Natural Resources
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October 1998

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New River State Park, NC

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Pre-Visit Activity #3 Pointing Out Pollution

Major Concepts:
- Watershed
- Water pollution
- Point source pollution
- Nonpoint source pollution

Learning Skills:
- Communicating, classifying, inferring, predicting
- Applying and expanding on information
- Group participation; map reading
- Problem-solving, measuring

Subject Areas:
- Science
- Social Studies
- English Language Arts
- Mathematics
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 20 - 30 students

Estimated Time: One to two class periods

Materials:
Provided by the park upon request:
Per educator: One Map of the New River Watershed in North Carolina already colored which will serve as answer key
Per Group: One laminated Map of the New River Watershed in North Carolina; set of overhead projector pens (colors: red, green, blue, and black)
Provided by the educator:
Per class:
Several magazine photographs, slides, or pictures of water pollution
Per group: Ruler
Per student: Student's Information; Can You "Detect" Potential Water Pollution Problems?; Pointing Out Pollution—Worksheet; pencil

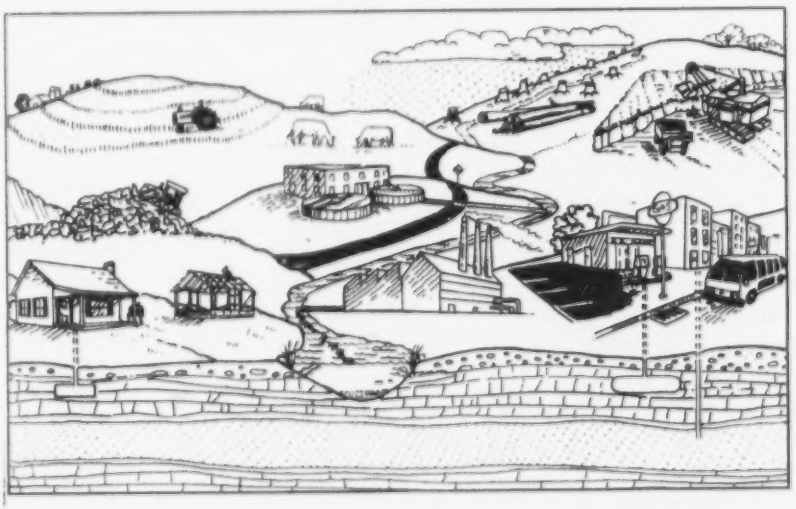
Credits: Student Sheet and illustrations copied with permission of the Tennessee Valley Authority from *Environmental Resource Guide — Nonpoint Source Pollution Prevention*, pp. 10 - 17.

Objectives:

- Define water pollution.
- Describe the difference between point and nonpoint source pollution.
- Using a legend, correctly locate specific features on a topo map such as rivers, towns, and the boundaries of the watershed.
- Draw inferences about human activities from a topo map and predict possible effects on specific watersheds.

Educator's Information:

This activity is designed to help students define **water pollution**, understand the difference between **point** and **nonpoint source pollution**, and identify on a **topographic** map some of the potential sources of water pollution. Additionally, it will help them understand the concept of **watersheds** and become familiar with the New **River Basin** in North Carolina. In Part I, students will use the illustration on page 3.3.7 and pictures of water pollution to distinguish point from nonpoint source pollution. In Part II, students will use the Map of the New River Watershed in North Carolina to outline the watershed including the North and South Forks of the New River; identify **tributaries**, towns, and wastewater treatment plants within it; and answer questions about possible influences on the New River's **water quality**. Students will work in groups to obtain answers for the worksheet.



Instructions:

Part I

1. Read and/or discuss the Student's Information with the class, making certain they understand the terms watershed, water pollution, point source pollution, and nonpoint source pollution.

2. Pass out the illustration, Can You "Detect" Potential Water Pollution Problems? Have the students identify possible sources of point and nonpoint source pollution and explain their answers.

Some possible answers:

Point Source

- wastewater treatment plant
- factory
- leaking underground storage tank
- septic tank

Nonpoint Source

- Forestry - logging activities
- Mining - (This could be point source if the pollutant can be tracked back to the mine. These sites are monitored under the Mining Act.)
- Runoff from streets and storm drains
- Nutrient (runoff) from farm fields and animal feed lots/pastures
- Air pollution from factory, buses, cars
- Runoff/**sediment** from construction sites

Your students may find other answers. Some pollutants could fall into either category.

3. Display slides, magazine photographs, or other pictures of water pollution. Ask students to describe their own observations of water pollution in their community or in places they have visited. What can be done to prevent water pollution?

Part II

1. Contact New River State Park at least one week in advance to borrow laminated copies of the Map of the New River Watershed in North Carolina.

2. Guided Practice: Divide students into groups of five or less. Give each group a laminated copy of the Map of the New River Watershed in North Carolina and a ruler. Point out the legend, the north arrow, and the map scale. Explain how to estimate distance using the map scale and a ruler.

3. Distribute a set of projector pens to each group. Pass out a Pointing Out Pollution–Worksheet to each student. Each student in the group should do one of the instructions under part A of the worksheet. We recommend that the students work together on part B, but that each student fill out his/her own copy of the worksheet.

4. Review the worksheet answers with the students.

Assessment:

Discuss the following questions as a class, or have students individually write their answers.

A. List the ways that people are using the **water** in the New River watershed (or the watershed that includes your school). (Answers: diluting wastewater, recreation, irrigation for crops, a water source for livestock or domestic uses, etc.)

B. As rain, snow, and other **precipitation** fall on the watershed, what do they come in contact with? (Answers: forests, fields, roofs, roads, parking lots, lawns, etc.)

C. What types of pollutants might the precipitation pick up as a result of these contacts? (Answers: fertilizers, **silt**, animal wastes, etc. from fields and lawns; petroleum products like oils, tar, gas and automotive fluids from roofs, roads and parking lots; litter from picnickers, campers and canoeists, etc.)

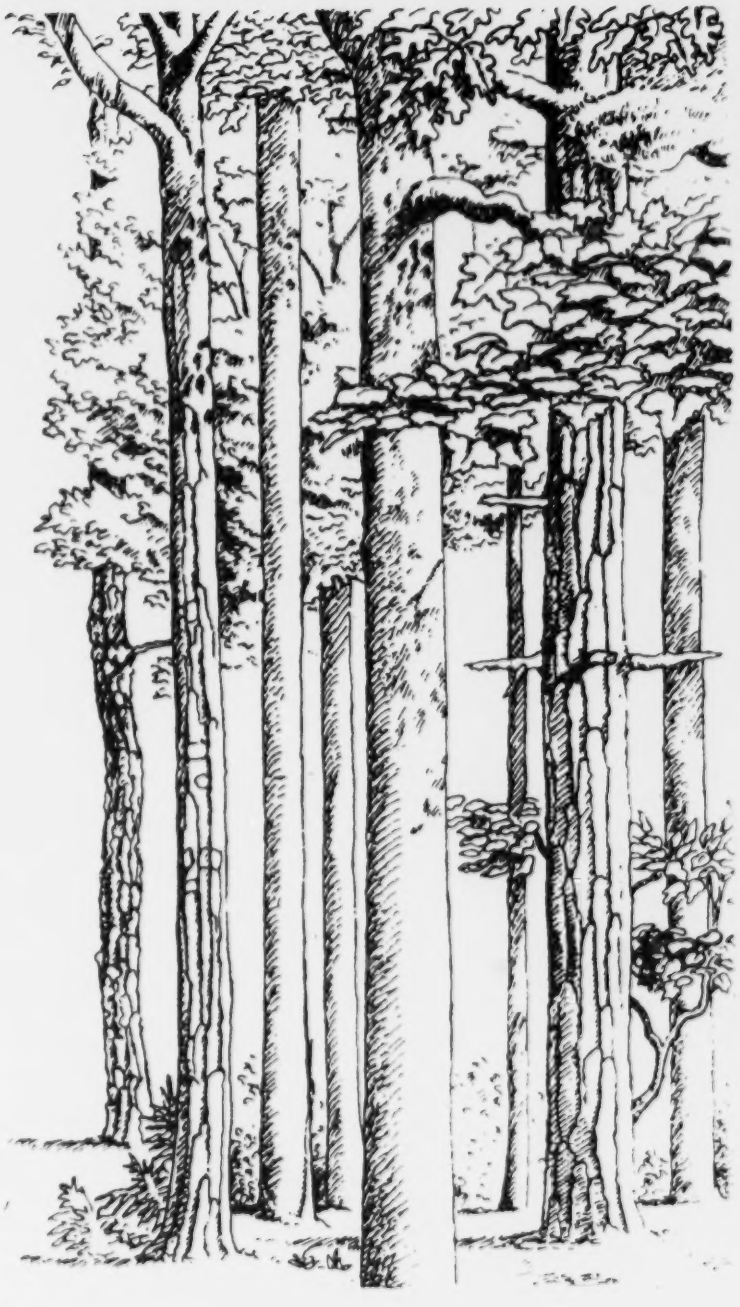
D. Identify less obvious ways the watershed community might pollute the waters. Categorize as point or nonpoint source pollution. (Sample Answers: overflowing sewage systems - point source; continuous disturbance of **soils** due to construction, agriculture and logging, leading to increased siltation - nonpoint source)

E. How can the watershed community protect the waters? (Answers: farmers and developers could use **erosion** control methods such as silt fences, terraces, and catchment basin ponds, as well as reduce use of fertilizers and pesticides; homeowners could reduce use of fertilizers and pesticides on lawns and gardens and maintain cars and sewer systems properly; landowners could maintain forests and/or stabilize soils by other methods; etc.)

Extensions:

1. Make students aware of the sources of point and nonpoint source pollution inside their school and outside on school grounds by taking a walking tour of the areas looking for examples.

2. Obtain topo maps for your area and use Part II of this activity to analyze your school's watershed. Compare two different watersheds in terms of the natural and human communities, possible sources of pollution, and the geology of the watersheds. Comparing watersheds from different countries or regions can be quite interesting.



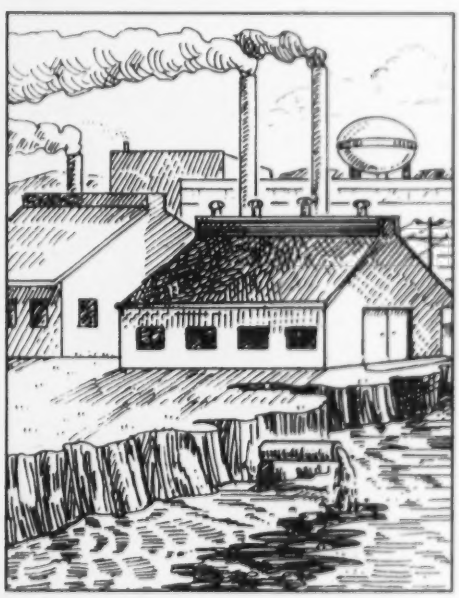
Student's Information

Each of us lives in a **watershed**. One way to picture a watershed is to think of a mountain valley. Imagine you are standing at the bottom of the valley, near a river. Looking up, you can see high ridges all around you. These ridges are the boundaries of the watershed. Since **water** always seeks the lowest level, all the **precipitation** that falls on the ridges and slopes will eventually end up in the river at the bottom of the valley. All the land between the high ridges and the bottom of the valley is part of this watershed. Activities that occur anywhere in the watershed will affect the river's **water quality**.

One way to understand a watershed is to look at a map. Find a river and its **tributaries**. If you think of the river as a giant tree and the tributaries as the tree's roots, all the land surrounding the "roots" is a part of this watershed. Whatever happens in the river's roots affects the entire river.

Point Source Pollution

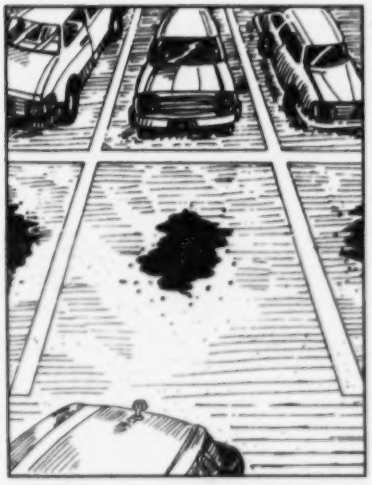
Unfortunately, many of our watersheds today are being damaged by pollution. **Water pollution** is generally defined as human-caused contamination of water that reduces its usefulness to humans and other **organisms**. Scientists divide water pollution into two major categories: point and nonpoint. **Point source pollution** comes from a localized source and is fairly easy to pinpoint. An example would be a specific type of chemical that a factory releases through a pipe into a stream. The factory may be the only source of that particular chemical in the watershed. If we found this chemical in the water, it would be very likely that the factory was the cause. We could prevent further pollution from this chemical by ordering the factory to stop discharging it into the water.



Nonpoint Source Pollution

Nonpoint source pollution cannot be easily traced to a specific source. It often occurs over large areas such as farms, grazing lands, logging roads, construction sites, abandoned mines, lawns, streets and parking lots. People can cause nonpoint source pollution by littering, disposing of household hazardous wastes and pet wastes in the wrong places, dumping motor oil on the ground, removing ground cover (or disturbing the **soil**), putting too much fertilizer on lawns and farmlands, using too many pesticides and herbicides, illegally discharging wastes from boats, using chemicals to de-ice sidewalks and driveways, etc.

Nonpoint source pollution does not enter the waterway at a single point or originate from a single location. Because of this, it is much harder to manage than point source pollution. One



specific example of non-point source pollution would be the motor oil that drips from cars onto parking lots. During periods of rain, all this oil washes into storm drains where it enters the city's water supply. It is impossible to pinpoint all the sources of motor oil in the watershed.

Types of nonpoint source pollution vary and examples include **sediment**, nutrients, and pesticides. Other significant nonpoint sources include **leachate** and runoff from waste disposal systems, farming, urban areas, mining and logging operations, and construction sites. In coastal areas, beach and shoreline **erosion** may be significant sources of nonpoint source pollution. In large cities, air pollution may be another major nonpoint source.

Sedimentation

Of all the types of nonpoint source pollution, sediment is one of the biggest contributors. Sediment pollution or erosion results mainly from row-cropping, livestock operations, construction sites, logging operations, and urban runoff. Sediment can have a negative impact on recreational, industrial, and municipal water uses, as well as on **aquatic habitats**. Sediment can also fill lakes, navigation channels and harbors. This can result in costly dredging operations. Sediment often carries other pollutants along with it.

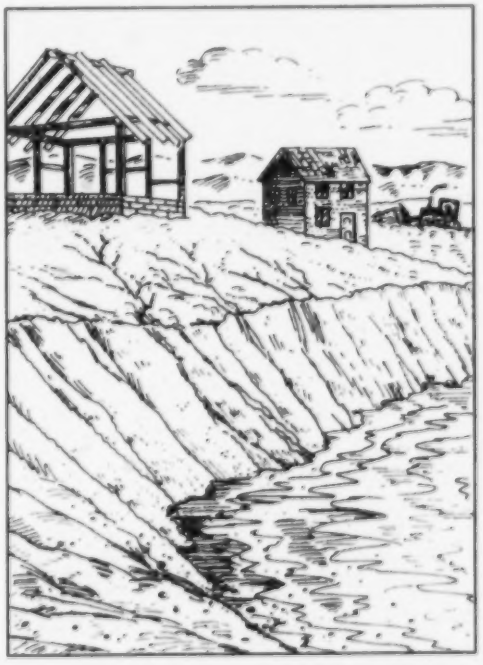
Nutrients

Other than sediment, the pollutants of greatest concern from rural and urban areas are nutrients, such as nitrates and phosphates, that stimulate plant growth. Nonpoint sources of nutrients include runoff from urban gardens and lawns, as well as animal wastes and inorganic fertilizers from agricultural runoff. Point sources include septic tank failures or discharges from wastewater treament plants. Too many nutrients can cause unsightly growths of **algae** and aquatic weeds, which can be harmful to the entire aquatic **ecosystem** and can reduce the usefulness of water bodies for water supply, recreation, and wildlife habitat.

Often nutrients enter water bodies along with large quantities of organic material such as soil. As they break down, they use up oxygen dissolved in the water. Algae, animal wastes, domestic wastes, and industrial discharges all contain substances that use up **dissolved oxygen** needed by fish and other aquatic animals. Fish kills occur when dissolved oxygen drops below levels required by the fish to breathe. As a result, fish suffocate.

Toxic Materials

Toxic substances such as heavy metals, oil and other dangerous chemicals, though existing in much smaller amounts, are a problem because of the



potential threat to human health and aquatic life. Nonpoint sources may include mining activities, pesticide use, runoff from animal operations, soil erosion, and runoff from urban areas. Point sources may be leachate from landfills, leaking underground gasoline storage tanks, and septic tank failures. Water bodies contaminated with bacteria or toxic metals and pesticides require extensive treatment to make the water safe for drinking or other household uses. Water bodies contaminated with disease-causing bacteria may have to be closed for swimming and fishing.

Air Pollutants

Finally, atmospheric pollutants can cause problems when they reach water bodies as wet or dry fallout. This is called **atmospheric deposition**. Wet fallout is when water vapor combines with pollutants in the atmosphere and is deposited in rain, snow and dew. Dry fallout is deposited as dust particles. Acid rain forms primarily when fossil fuels are burned. Acid rain reaches water bodies either directly as rain or snow from contaminated clouds, or when dry fallout is dropped on land and washed into water bodies as runoff or snow melt.

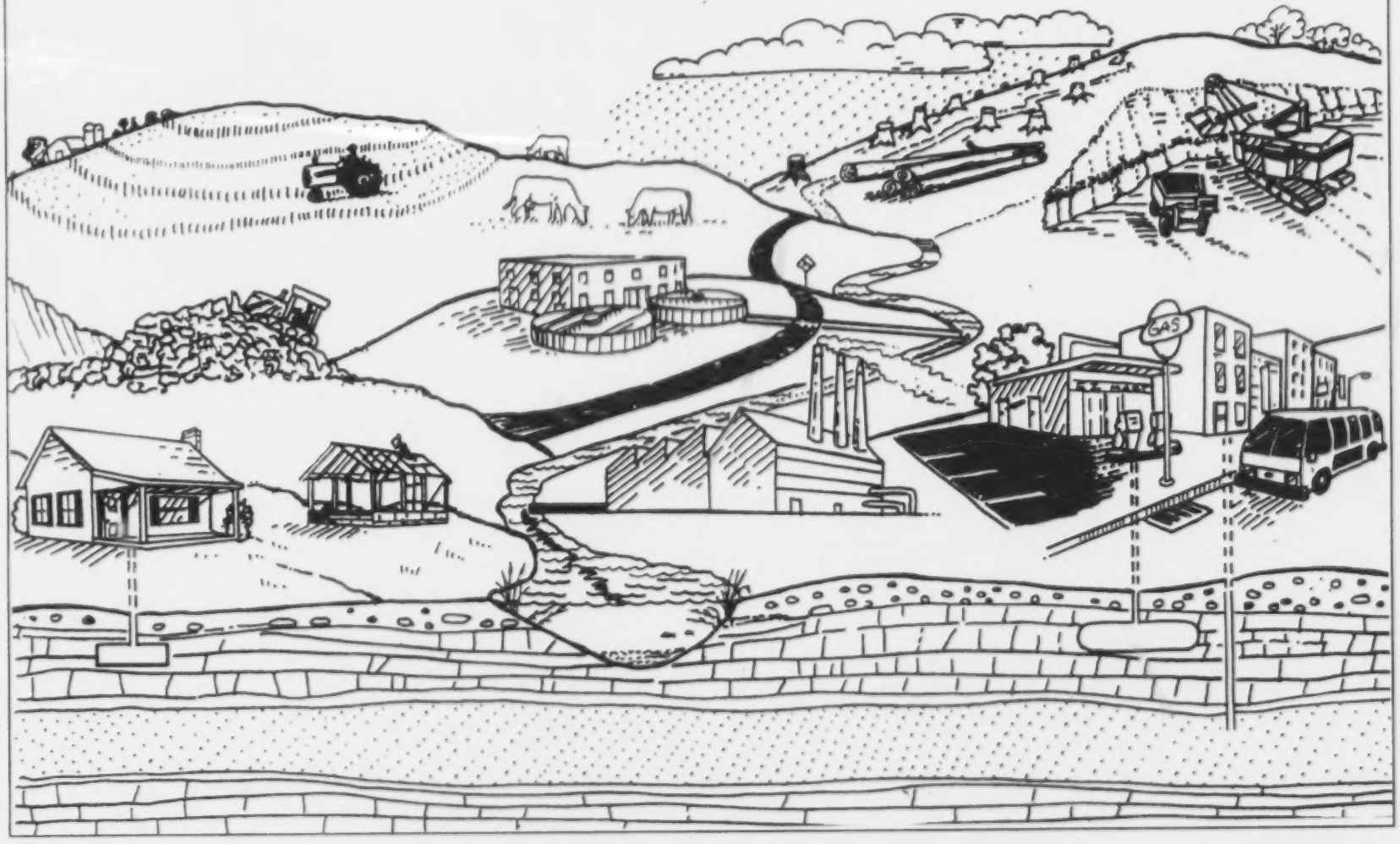
Prevention & Control

The most effective way to control water pollution is to reduce nonpoint sources. Erosion, for instance, is a major contributor of sediment, nutrients, toxics, and oxygen-using pollutants. No-till and reduced tillage agricultural practices, contour plowing, and controlled drainage (use of grassed waterways, berms, and tile drainage systems) protect water bodies from the excessive erosion associated with row-cropping. Controlling runoff from livestock operations, reclaiming strip mine areas, carefully constructing logging roads with water diversions, using good forest harvesting practices, and exercising good judgement when planning and carrying out construction activities can all help control erosion. What can you do to control erosion in your yard or on the school grounds?

By using our cars less, we can help reduce atmospheric deposition. Recycling can decrease the need for landfills and reduce the potential for **groundwater** contamination from leachate. These are just a few of the many ways water pollution can be reduced or eliminated.

It is important to realize that although we study individual watersheds, the watersheds are actually connected to one another. If one watershed becomes contaminated, it will eventually affect the watershed downstream. As water flows downstream, contaminants can accumulate and cause even greater damage to watersheds near the ocean.

Can You "Detect" Potential Water Pollution Problems?



Pointing Out Pollution — Worksheet

Student Name: _____

A. Exercises: Use only the projector pens provided

1. With the blue marker, trace the flow of both the north and south forks of the New River from their headwaters to the Virginia state line.

2. Locate all of the towns above a population of 500 in the New River watershed in North Carolina and circle them with the green marker.

3. Trace all of the named creeks and tributaries shown on the Map of the New River Watershed in North Carolina with the blue marker.

4. Trace the boundary of the New River watershed in North Carolina with the red marker.

5. Circle the designated Federal and State Wild and Scenic River section of the New River with the black marker. (Hint: The scenic section of the river is the stretch of river found within the boundaries of New River State Park.)

B. Questions

1. Count all of the named creeks and tributaries in Alleghany County that empty into the New River. How many are there? _____ List the name(s).

2. There are 825 miles of freshwater streams in the New River watershed. Using the scale at the bottom of the map and a ruler, estimate the lengths of Roundabout, Peak, Long Hope, and Howard creeks in miles. Also include total approximate miles of these four creeks.

Roundabout Creek = _____ Peak Creek = _____

Long Hope Creek = _____ Howard Creek = _____

Total Approximate Miles = _____

3. Knowing that the watershed is in the shape of a triangle (roughly), determine its approximate area in square miles by measuring outside the boundarines and using the following formula:

Area of a triangle = 1/2 base x height

4. How many towns, shown on the map, are in the New River watershed? _____
List their names.

5. How many permitted wastewater discharge sites are located on the New River in North Carolina? ____ Notice the town closest to each and explain how the discharge sites might affect the river.

6. Approximately how many miles is it along the New River from where U.S. 221 crosses the South Fork New River (near Cranberry Creek) to where the North and South forks of the New River meet? _____

7. The Average Flow Rate (how fast the water flows) of the New River is 5 mph. If a fuel tanker wrecked at the U.S. 221 bridge over the South Fork New River (near Cranberry Creek) and gasoline spilled into the river, how long would it would it take for the fuel to reach the point where the north and south forks of the New River merge?

Hint: Use the answer from question #6 as Distance Traveled in the equation below:

Distance Traveled divided by Average Flow Rate = Amount of Time in Hours

8. If a chemical spill occurred at a farm in Ashe county releasing chemicals into the upper section of Big Horse Creek, which town would be affected more, Lansing or Crumpler? _____ Why?

9. Which section of the New River would you expect to have the best water quality? _____ Why?

10. Name some possible sources of pollution in the New River watershed. Then describe the type(s) of pollutant that each source might contribute.

SOURCE	LIST/DESCRIBE THE WATER POLLUTION
ex: road	*oil and other chemicals from cars*

Pointing Out Pollution — Answer Sheet

A. Exercises: Use only the projector pens provided

1. With the blue marker, trace the flow of both the north and south forks of the New River from their headwaters to the Virginia state line.

2. Locate all of the towns above a population of 500 in the New River watershed in North Carolina and circle them with the green marker.

3. Trace all of the named creeks and tributaries shown on the Map of the New River in North Carolina with the blue marker.

4. Trace the boundary of the New River watershed in North Carolina with the red marker.

5. Circle the designated Federal and State Wild and Scenic River section of the New River with the black marker. (Hint: The scenic section of the river is the stretch of river found within the boundaries of New River State Park.)

(***See colored Map of New River Watershed in North Carolina for answers to Exercises 1 - 5)***

B. Questions

1. Count all of the named creeks and tributaries in Alleghany County that empty into the New River. How many are there? 1 List the name(s). *Prathers Creek*

2. There are 825 miles of freshwater streams in the New River watershed. Using the scale at the bottom of the map and the ruler, estimate the lengths of Roundabout, Peak, Long Hope, and Howard creeks in miles. Also include total approximate miles of these four creeks.

Roundabout Creek = 3 miles

Peak Creek = 5 miles

Long Hope Creek = 7 miles

Howard Creek = 9 miles

Total Approximate Miles = 24 miles

3. Knowing that the watershed is in the shape of a triangle (roughly), determine its approximate area in square miles by measuring outside the boundaries and using the following formula:

Area of a triangle = 1/2 base x height

Sample calculation:

Area of watershed = 45 miles x 30 miles = approx. 675 square miles

(**Note:** Student answers will vary. The exact figure according to the North Carolina Division of Environmental Management, Water Quality Section, is 765 miles.)

4. How many towns, shown on the map, are in the New River watershed? 12

List their names. (**Note:** The map only shows towns above a population of 500.)

Jefferson	*Blowing Rock*	*Glendale Springs*	*Fleetwood*
Boone	*Crumpler*	*Laurel Springs*	*Deep Gap*
Lansing	*West Jefferson*	*Todd*	*Creston*

5. How many permitted discharge sites are located on the New River in North Carolina? 14 Notice the town closest to each and explain how the discharge sites might affect the river.

• *During periods of heavy rain, these wastewater treatment plants may back up; untreated sewage may flow directly into the river. During periods of drought when the streams are low, the percentage of stream flow composed of treated sewage is greatest and may harm aquatic life. Also, these wastewater treatment plants are a major source of chlorine in the New River. Although chlorine breaks down and is diluted quickly once it enters water, its toxic effects can harm sensitive aquatic life such as trout and mussels.*

6. Approximately how many miles is it along the New River from where U.S. 221 crosses the South Fork New River (near Cranberry Creek) to where the North and South forks of the New River meet? 10 miles

7. The Average Flow Rate (how fast the water flows) of the New River is 5 mph. If a fuel tanker wrecked at the U.S. 221 bridge over the South Fork New River (near Cranberry Creek) and gasoline spilled into the river, how long would it would it take for the fuel to reach the point where the north and south forks of the New River merge?

Hint: You need the use the answer to question #7 to figure this one out.

Distance Traveled divided by Average Flow Rate = Amount of Time in Hours

10 miles divided by 5 miles per hour = 2 hours

8. If a chemical spill occurred at a farm in Ashe County releasing chemicals into the upper section of Big Horse Creek, which town would be affected more, Lansing or Crumpler? *Lansing* Why? *It is closer to the spill site, less time for the chemical to be diiluted by the water in the river.*

9. Which section of the New River would you expect to have the best water quality? *The Federal and State Scenic Section (from Dog Creek to the Virginia state line.)* Why? *No significant industry, low population, no large housing developments. Primarily agricultural runoff and sediment runoff from steep slopes.*

10. Name some possible sources of pollution in the New River watershed. Then describe the type(s) of pollutant that each source might contribute.

SOURCE	LIST/DESCRIBE THE WATER POLLUTION
ex: road	*oil and other chemicals from cars*
homes	*untreated sewage from leaky septic tanks*
gas stations	*gasoline from leaky storage tanks*
logging operations	*runoff — sediment*
canoeists and picnickers	*litter*
housing developments	*runoff — sediment, fertilizers, pesticides*
agriculture	*fertilizers, animal waste, pesticides, herbicides*
industry	*chemicals, dyes*
parking lots	*roadside trash washing into river during rains*
tree farms	*pesticides, herbicides, fertilizers*
wastewater treatment facilities	*untreated waste during periods of flooding*
storm drains	*sediment, litter, fertilizer, motor oil*
homes under construction	*runoff from unstabilized lots*
roads under construction	*unpaved roads put in at steep angles allow much sediment runoff into river*

On-Site Activity #1 — Life in the Fast Stream

Curriculum Objectives:
Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Mathematics: whole numbers, measurement
- Science: interactions of people and the environment, organization and variety of living things, plant and animal communities
- Social Studies: evaluate, organize, and analyze information draw, conclusions

Grade 8
- Communications Skills: listening, visual, reading and vocabulary comprehension
- Mathematics: whole numbers, measurement
- Science: adaptation, ecology
- Social Studies: evaluate, organize and analyze information, draw conclusions

Location:
New River, Wagoner Road Access Area

Group Size:
30 or fewer, in groups of 5 or less

Estimated Time:
1 - 1 1/2 hours

Appropriate Season:
Late May to early October

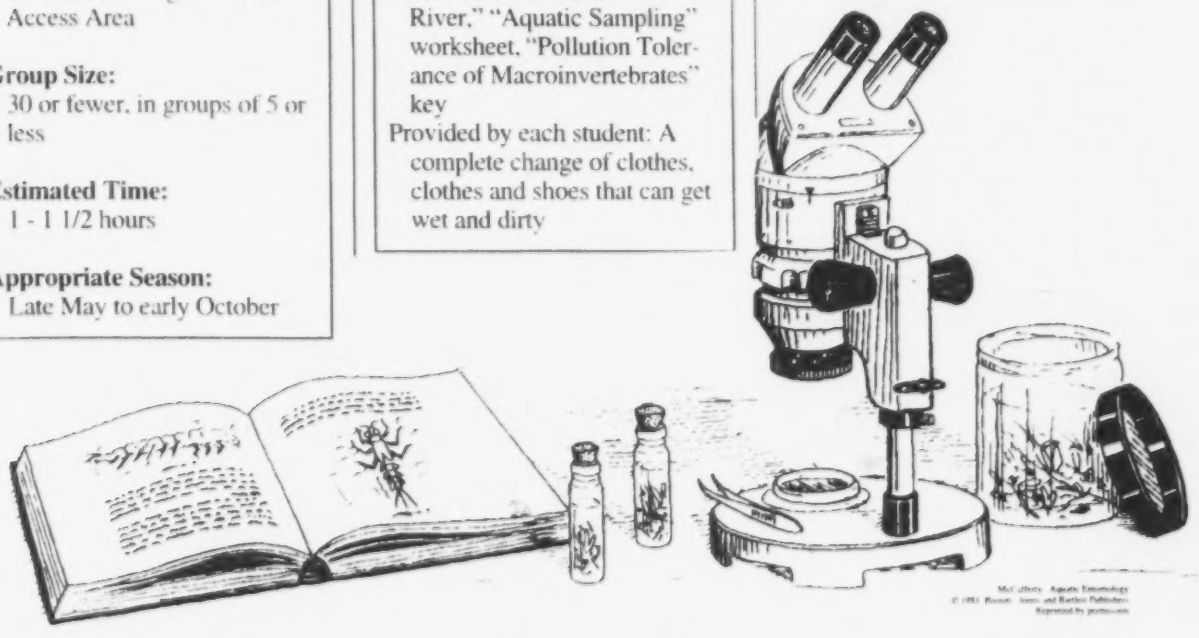
Credits:
Adapted from "A Field Manual for Water Quality Monitoring, an Environmental Education Program for Schools" by Mark K. Mitchell and William B. Stapp; and Aquatic Project WILD Guide - "Water Canaries" activity, 1986, Western Regional Environmental Education Council.

Materials:
Provided by park:
Per student: life jacket, pencil
Per group: kick net, dip net, rubber gloves, wide mouth plastic jars, aquariums, plastic tubs, dissecting scope, magnifying glasses, tweezers, clipboard, field guides to aquatic life, laminated fish and invertebrate keys, aquarium nets, plastic spoons, extra activity sheets, examples of adult macroinvertebrates
Per class: remarkable board, rescue throw rope
Provided by the educator:
Per student: "Key to Common Macroinvertebrates of New River," "Aquatic Sampling" worksheet, "Pollution Tolerance of Macroinvertebrates" key
Provided by each student: A complete change of clothes, clothes and shoes that can get wet and dirty

Note: There is a public restroom located close to the activity site where the students can change clothes.

Special Considerations:
Remind the students of the appropriate dress for the on-site activity (i.e. old shoes without holes in them, old jeans, etc.) Students must wear life jackets and shoes during this activity. Students should wear gloves when sorting and handling organisms so they can be returned without injury to the water after the activity.

It is the responsibility of the educator and group leaders to be aware of special considerations, medical needs, disabilities, etc., of participants and be prepared to take appropriate precautionary measures. Park staff should be informed of any special considerations prior to the group's arrival at the park.



Major Concepts:

Part I

- Water quality
- Aquatic sampling
- Indicator species
- Aquatic habitats
- Species identification
- Biotic index
- Human influence on water quality

Part II

- Water flow
- Human influences on water flow and aquatic life
- Natural influences on water flow and aquatic life
- Water quality
- Stewardship

Objectives:

Part I

- Describe three characteristics of an aquatic macroinvertebrate.
- Key out five macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- List three or more ways humans affect aquatic life.

Part II

- Calculate the rate of water flow.
- List three human actions and three natural influences on water flow.
- Explain the relationship between water quantity and quality.
- Describe three problems that can result from water quantity extremes and three from water quality changes.
- Discuss two ways people can help protect rivers and water quality.

Part I: What's In The Water?

Educator's Information:

To prepare your students for their visit, have the students read the Student's Information and complete the pre-visit activity "The Keys To Knowledge." Discuss these topics as a class prior to your visit.

In the early days of coal mining, canaries were taken into mines. Canaries are more sensitive than humans to the presence of dangerous gases in the air, therefore their discomfort or death indicated the air was unsafe for the miners to breathe. Although this practice no longer exists, it stands as an example of how animals have different sensitivities to environmental factors than humans.

In **aquatic** and terrestrial environments, certain organisms called **indicator species** can reveal much about the quality of the environment. These creatures comprise a **biotic index**. Their absence or presence tells us something about the environment's quality.

Water **habitats** with rich and varied ranges of aquatic creatures are usually "**healthy**" environments, whereas **water** with just a few different species usually indicates conditions that are less "healthy." Healthy is a term used here to indicate an environment that supports a wide variety of living things. **Pollution** reduces the quality of the environment and in turn the **diversity** of life forms. In some cases the actual biomass, or amount of living material, will increase due to pollution, but the diversity inevitably goes down.

The major purpose of this activity is to introduce students to **macroinvertebrates** and aquatic **organisms** and how they can be used as indicator species to determine the health of a river. We expect the students will find the biotic index for the New River very high, due to the quality of the water.

The students will be involved in collecting macroinvertebrates from the river and must be dressed appropriately. Life jackets must be worn at all times. A first aid kit will be available. The park staff will rope off an area where the sampling will occur. They will discuss safety considerations and the educator will

assist in seeing that all safety precautions are followed. The students will work in groups of four or five, with one person in each group recording the data. After completing the worksheets, students will gather and discuss their results.

Start by observing the water. Look for organisms on the surface and in the depths. Using the sampling equipment (nets, trays, assorted containers, etc.), students should collect as many different forms of aquatic animal life as possible. Ask them to be alert to differing micro-habitats located near rocks, in **riffles** and in eddies. Place the collected animals in the white trays, plastic jars or aquariums for viewing and keying out. The whiteness of the trays allows details to be seen in the animals collected. Keep an adequate amount of water in the trays and place them in a cool, shady spot. Change the water as often as necessary to keep the animals cool and alive.

Note: These animals are protected by park rules and regulations. By exercising care all the animals can be returned to their home without being harmed.

Have the students use their aquatic macroinvertebrate identification **key** to identify the animals. Have them fill out their worksheets listing the number of each species found and describing the actual locations where they were found, i.e., in pool areas, under rocks, the water's surface, etc. Once these observations and the worksheets are completed, carefully return the animals to their natural habitat.

Encourage the students to discuss their observations. How many different aquatic animals were found? Discuss diversity of life and that a variety of different kinds of plants and animals is usually an indication of a healthy **ecosystem**.

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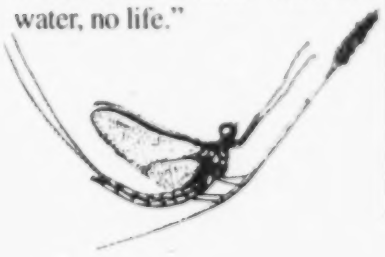
Student's Information

"**Water**, Water everywhere nor any drop to drink."

So says the sailor in Samuel Taylor Coleridge's "Rime of the Ancient Mariner" as their boat is becalmed at sea. Fortunately, in our area fresh water is abundant and there seems to be plenty to drink. But that may be changing as this area becomes more developed and is used by more people. Let's take a closer look at water and discover what a fragile and sensitive resource it is.

What is water? The dictionary defines water as a colorless, odorless, transparent liquid occurring on earth as rivers, lakes, oceans, glaciers etc., and falling from the clouds as rain, snow, ice, etc. Water occupies more than 70 percent of the earth's surface, and it makes up approximately 60 percent of the human body. You may have heard the saying "Water is life." Think about that for a minute. Can you think of any living **organism** that does not depend on water?

David Quammen, in his book, *Natural Acts, A Sidelong View of Science and Nature* says, "Without life, there would still be water. Without water, no life."



Recipe for a River

Water comes in many forms. To really appreciate it you need to pick out one of its many forms and get to know it personally. During your visit to New River State Park you will learn more about water in the form of a river.

What is a river? A river is defined as a large, natural stream of water emptying into an ocean, lake or other body of water and usually fed along its course by converging **tributaries**. The New River is one of the oldest rivers in the world which is one of the reasons that the New River State Park was established. The river is the result of springs, streams and creeks joining together to produce a larger **volume** of flow. These smaller bodies of water are called tributaries. The land that a river and its tributaries flow through is called a **watershed**. A **healthy** river must have a well protected watershed because any kind of disturbance to the watershed has an effect on the river.

Life in a River

The various forms of life found in a river can be compared to a fine stew or soup. Just like a river, a fine stew or soup needs lots of different ingredients. Usually the more you add, the better the stew. A stew also needs small amounts of spices to make it taste just right. If you try to make a stew with just one ingredient, or if you leave out an important spice, your stew is not going to be good. Here then is a recipe for a fine, healthy river.

Some sunlight - just enough for **algae**, moss, diatoms and **aquatic** plants to **photosynthesize**. (Too much sun heats up the water and robs it of **dissolved oxygen**.)

Dissolved oxygen and carbon dioxide - all the animals in the river need dissolved oxygen to breathe. These same animals breathe out carbon dioxide which is essential for algae and other aquatic plants. These plants in turn take in the carbon dioxide and give off oxygen.

Fallen leaves - they provide the main source of food energy in a river system. In the fall, leaves drift down from the trees into the water where they soon sink to the bottom or get caught in logjams or become wedged between rocks. At this point, bacteria and fungi climb aboard the leaves and begin to "munch out," causing the leaves to decompose and break down into smaller pieces. The half-eaten leaves, along with the **decomposers**, are eventually swept downstream. They provide food for filter feeders - the wonderfully adapted **macroinvertebrates** (macros), such as stonefly **nymphs**, mayfly nymphs, and caddisfly **larvae**. These organisms

further break down the leaves into a very fine mulch called **detritus**.

In addition to the munchers, grazers and filter feeders, there are macroinvertebrates that prey on other macros. Lots of different kinds of macros are a sign of a healthy river.

Aquatic plants and animals - aquatic plants provide cover for macros and small minnows. The aquatic plants and animals in the river, and those living along the river provide food for each other in a complex **food web**. When all these various plants and animals die or excrete waste, they return essential nutrients back into the **food chain**.

Various minerals - the fine spices of a river include calcium bicarbonate, potassium, nitrates and phosphates. These ingredients help balance a rivers pH, provide building material for the shells of **snails**, **mussels**, clams and crayfish, help fish breathe more efficiently and act as natural fertilizers essential for aquatic plants.

These are just the minimum ingredients needed for a healthy river. Now mind you, a river needs only natural ingredients, unnatural ingredients can have a bad effect on a river. David Quammen sums up what makes a healthy river when he talks about a trout stream.

"A good trout stream must first be an excellent insect stream, a superior haven for algae and fungi and bacteria, a prime dumping ground for dead leaves, a surpassing reservoir of oxygen and calcium. It will then also, and thereby, be a good **osprey** stream, a favorite among otters, a salvation to dippers and kingfishers and bank swallows and heron, mergansers and Canada geese and water shrews, mink and muskrat and beaver. Not to mention the occasional bear. And who knows but that, sometime, a human might want to drink."

If there are large numbers of many different species of plants and animals in the water, then we have a healthy river. Taking samples of these aquatic plants and animals is a means to monitor the **quality** of a river's water.

Instructions:

1. Park staff will lead a brief discussion focusing on: macroinvertebrates (macros), what they are and why they are important; **metamorphosis**, what it is and how it is accomplished; and **indicator species**, what they are and how they are used to determine the health of a river. The staff will point out and describe the river's environment: **riparian** areas, flood plain, **pools**, eddies, ripples, etc. Park staff will also cover how to use sampling equipment and safety precautions that must be followed when using the equipment.

2. Have the students predict the **biotic index** for the New River on their worksheets.

3. Briefly review the macroinvertebrate **key**. Be sure to point out that the key is not complete and the students should therefore key organisms as closely as possible. For example, there are 186 dragonfly **species** in North Carolina, and the key only shows one dragonfly larva species, but the illustration should be close enough so the students will be able to identify any dragonfly larva they find.

4. a. Divide the class into groups of five or less and distribute their equipment.

b. Instruct the students on the proper way to collect samples using dip, seine and kick nets.

c. Fill the white trays, aquariums and plastic jars half way with water from the river.

d. Have the students net their samples in the roped off area.

e. As soon as the samples are collected, the groups should move to the river bank.

f. Allow the excess water to drain from the nets.

g. Put on rubber gloves and search for organisms. (They may want to use a magnifying glass.)

h. Using tweezers or hands, carefully remove any organisms found and place in the white tray, aquarium or plastic jar for observation and identification.

5. After collecting samples, each group should identify the aquatic macroinvertebrates using the "Key to Common Macroinvertebrates," field guides and dissecting scopes. Have them record their answers on the "Aquatic Sampling Data Sheet" and use their results to determine the Biotic Index Value (relative health) of the river.

The Biotic Index Value groups macros into three groups based upon how tolerant or sensitive they are to changes in **water quality**.

Group I includes macros that are very intolerant to water pollution. The dominant presence of Group I species is an indication of good water quality. Group I is given an index value of 3. Group II includes macros that are moderately tolerant to a reduction in water quality. They are given an index value of 2. Group III represents macros that are tolerant to pollution. Their dominance indicates poor water quality. They are given an index value of 1. The students will learn how to calculate the Biotic Index Value by using a simple formula:

(3 x no. of Group I)
(2 x no. of Group II)
+ (1 x no. of Group III)

= **Biotic Index Value**

6. Return all organisms to the water as quickly as possible after the observation and identification is complete to help insure that the organisms are not harmed.

7. After the students have identified their specimens and determined the Biotic Index Value, park staff will lead a group discussion summarizing what the students have learned, what they've identified from the river, and the importance of indicator species and the Biotic Index Value.

8. Instruct the groups to gather and clean their equipment. The rangers will tell the students where the equipment should be placed.

9. Assemble the class and have each group present their findings. According to their study, what is the rating of the New River's water quality? How does it compare to the students' initial prediction? If different, encourage students to explore reasons. Do different groups have different results? If so, explore reasons why. (Answers: improper collection or identification techniques by some; luck of the hunt, etc.)

Aquatic Sampling Worksheet

Name: _____ Date: _____

Location: _____

Methods used to sample: _____ Biotic Index Value: _____

A. Prediction of the New River's Biotic Index: Excellent Good Fair Poor

Circle your choice. Why do you think the New River will have this Biotic Index?

_____

_____

B. Instructions:

1. Use the "Key to Aquatic Macroinvertebrates" or "Pollution Tolerance of Macroinvertebrates" chart to identify organisms.
2. Record the species of organisms found in the space below, using the chart to classify them by their tolerance levels. (See example below.)

Group I	**Group II**	**Group III**
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
Total =	Total =	Total =

3. Calculate the Biotic Index Value by multiplying the number of species of organisms in each group by the index value for that group. Then, add the resulting three numbers to obtain the Biotic Index Value (see example below).

(3 x no. of species - Group I)
(2 x no. of species - Group II)
+ (1 x no. of species - Group III)
= **Biotic Index Value**

Cumulative Index Values	**Biotic Index Rating**
23 and above	Excellent
17 to 22	Good
11 to 16	Fair
10 to less	Poor

Group I	Group II	Group III
1. hellgramite *4. caddisfly*	*1. dragonfly*	*1. black fly*
2. mayfly *5.*	*2. crayfish*	*2. freshwater worm*
3. snail	*3.*	*3.*

(3 x **4**) + (2 x **2**) + (1 x **2**) = **18**

[**18** is the biotic index value, which is a good rating according to the chart above]

Adapted from *A Field Manual for Water Quality Monitoring*, An Environmental Education Program for Schools by Mark K. Mitchell and William B. Stapp.

4. How would you describe the river's water quality based on its Biotic Index?

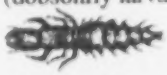
5. What do you think has caused or contributed to the water quality?

Pollution Tolerance of Macroinvertebrates

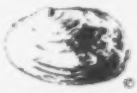
Group I - Index Value = 3
These macroinvertebrates can not tolerate pollution or changes in water quality. Their presence or dominance generally indicates good water quality.

mayfly nymph

Hellgrammite
(dobsonfly larva)



freshwater mussel



stonefly nymph

riffle beetle adult

right-handed pouch snail

water penny
(riffle beetle larva)

caddisfly larva

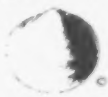
Group II - Index Value = 2
These macroinvertebrates can exist in a wide variety of water quality conditions.

dragonfly nymph

damselfly nymph

crayfish

freshwater clam



scud

whirligig beetle

water strider

Group III - Index Value = 1
These macroinvertebrates can exist in polluted water. Their dominance indicates poor water quality.

black fly larva

leech

freshwater worm

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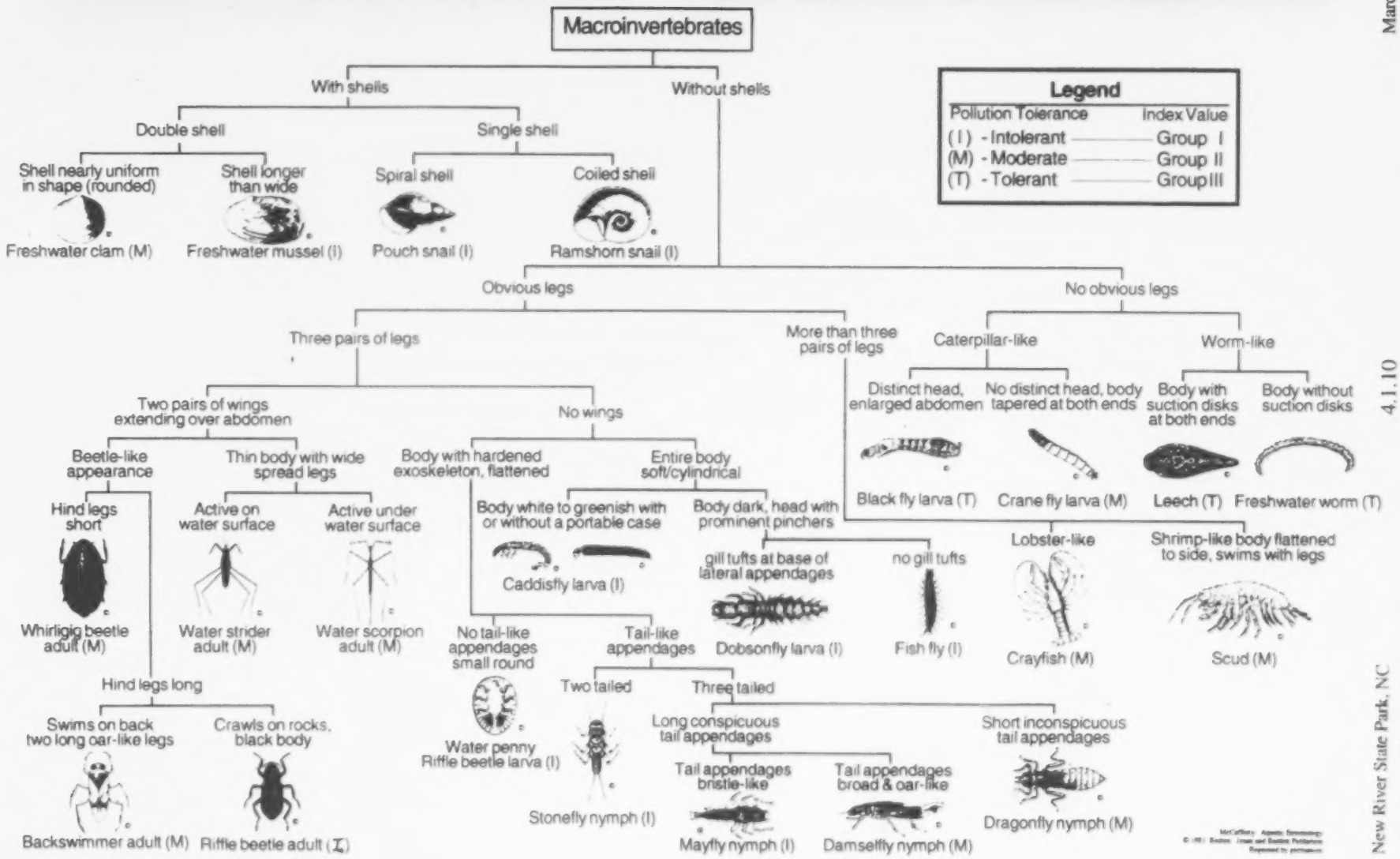
Key To Aquatic Macroinvertebrates
of the New River



March 1994

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New River State Park, NC

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Part II: Calculating Water Flow of the New River

Educator's Information:

In this activity, the students will learn a simple method for determining water flow. They will then use this information to explore the ways water flow and water quality are affected by human and natural factors. They will also be asked to think of ways they can influence local government to protect water quality.

Have students read the Student's Information. Discuss this information in class prior to your visit.

Instructions:

1. Lead a brief discussion concerning the importance of water flow in maintaining water quality. Explain that in this activity, the students will learn how to calculate water flow and thus be able to evaluate this aspect of the New River's water quality.

2. Explain the method for measuring water flow and safety procedures that must be followed.

3. Select three students, wearing life vests, to get in the water. Have two students measure the length and width of the flow space and one student measure the depth. Have the other students write down the measurements on their worksheets.

4. Select four students, wearing life vests, to measure the rate of flow. Have two students, each with a bouyant ball, go to the upstream end of the flow space. Have two other students, each with a stopwatch, go to the downstream end of the flow space. The student with ball #1 should place it in the river, upstream from the beginning of the flow space, and hold his/her hand in the air. As the ball passes the beginning of the flow space, he/she quickly drops his/her hand. This is the signal for the student with stopwatch #1 to start the stopwatch. The stopwatch is stopped the moment the ball passes out of the flow space. The student will then retrieve the ball, and they will repeat this procedure four more times. The students with ball #2 and stopwatch #2 will follow the same procedure as the #1 team. The other students will record the flow rates on their worksheets as the students with the stopwatches announce them.

5. Have all the students determine the averages and then calculate the water flow rate in cubic feet/second. Discuss these results and what they might mean to the New River's water quality.

6. Lead a discussion of factors that affect water flow (natural and human), and how these factors in turn affect aquatic life. Natural factors affecting water flow include drought, flooding and natural stream obstruction, i.e., beaver dams, rapids or log jams. Human activities that affect water flow include dams, irrigation, clear-cutting of timber, development along the river's corridor and industrial use. These natural and unnatural water controls can adversely impact aquatic organisms by reducing water flow and decreasing water quality.

7. Ask the students how they can influence the government to protect our water resources. Be sure to emphasize the importance of everyone being involved in caring for our resources (**stewardship**). The National Committee for the New River is an organization that exemplifies stewardship. If time allows, the leader will briefly explain how the park was created with the help of the National Committee for the New River.

Suggested Extensions:

1. Have the class compare their findings with other classes that have done this activity in the past by comparing worksheets. The worksheets may be different due to collection and identification techniques, luck of the hunt, weather, water level, season, etc.

2. Sample other streams and rivers in the area and compare their biotic index value with that of the New River.

Student's Information

Water flow refers to the amount of water moving in a river or stream. Some of the ways we express the rate of flow are gallons per second, cubic feet per second or acre feet per second (an acre foot is equal to one acre of water one foot deep or 325,850 gallons of water). The following exercise will show you how to estimate water flow in cubic feet per second. Why is this important? Read the following story and discover why water flow is such an important concept.

The river is the Colorado. It begins in the Colorado Rockies and empties 1,450 miles later into Mexico's Gulf of California. The Colorado River provides water for seven western states. This includes water for human consumption as well as irrigation for farms and domestic livestock. The river also provides the necessities of life for many native plants and animals. The Colorado is one of the most controlled rivers in the world; it has scores of dams, hundreds of miles of aqueducts and tunnels, dozens of pumping stations, thousands of miles of canals, and more than 30 hydroelectric plants. Water is pumped from the Colorado to cities like San Diego, California; Las Vegas, Nevada; Denver, Colorado and Phoenix, Arizona. Each year 16.5 million acre feet of water are diverted from the Colorado River (multiply 16.5 million times 325,850 to see how many gallons are taken from the river each year). Sometimes the water level is so low that rafters can not run certain rapids in the Grand Canyon.

Dams above the Grand Canyon control how much water moves through the canyon. This has had a big impact on aquatic life. For example, before the Colorado River was dammed, the river flowed cold and carried lots of mud and **silt** during the spring floods and slowed to a warm clear trickle in the fall. Native aquatic species were well **adapted** to these specific conditions. Now dams trap **sediment** in huge reservoirs and constantly release clear cold water from the bottom of the lake. This has created excellent **habitat** for species brought in to the river, like trout, but is contributing to the near extinction of several **native** species of fish that do not tolerate the cold water well.

By the time the Colorado River reaches the Gulf of California there is barely a trickle of water, and at times the river dries up before it reaches the gulf. Even if there is water flowing, evaporation has caused the water to become so salty it cannot be used for irrigation.

A huge **delta** and **estuary** at the mouth of the Colorado was once one of the most productive in the Southwest, but a decrease in water flow has changed that. In 1922, ecologist Aldo Leopold explored the delta. He described it as a milk and honey wilderness where egrets gathered like a premature snow storm, jaguars roamed and wild melons grew. Since that time two marine animals have become endangered: a porpoise and a large fish called a totoaba. The totoaba spawned in the estuary and the tide carried their eggs

into the natural nursery of the delta. According to saltwater agronomist Nicholas Yensen, the river was like the Nile in its importance to the delta. Unknown species may have disappeared as a result of the decrease in water flow.

You might be surprised to learn that even the New River is affected by low water flow. Such conditions can have adverse effects on the entire aquatic **community**.

When water levels are low the water temperature can increase, which can result in less dissolved oxygen being available. This can be dangerous to macroinvertebrates and fish.

Algae, which uses tremendous amounts of oxygen as it decays, can spread rapidly during low water flow. Because of this, fish kills will sometimes occur because of insufficient dissolved oxygen.

During low water levels there is less habitat for river animals, making them more vulnerable to **predators**.

You might be forced to conserve water during low flow periods to make sure you and your neighbors have enough to drink and bathe.

We have talked a lot about low water levels, but high water levels can also affect life along the river. Heavy rains wash exposed **soil** into the river. This sediment can suffocate macroinvertebrates, kill fish eggs and alter habitats. Many towns and cities divert rain water into storm drains that empty into rivers. This storm water brings all kinds of nasty things into the river: vehicle oil and gas from pavements; chemicals used in farming and lawn care; overflow from waste water treatment plants; and trash from dumps and other sources.

As you can see, water flow is very important to us and the plants and animals that share the New River with us. Using water wisely and protecting our river's watershed from unwise use are two ways we can help maintain a healthy environment and a more natural water flow.

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How To Calculate Water Flow Worksheet

A - Average length of flow space
B - Average width of flow space
C - Average depth of flow space
D - Time of flow through space

Solving for X = water flow rate in cubic ft./sec.

Equation: A x B x C ÷ D = X

A **Average length of flow space**

North bank _____ ft. + South bank _____ ft. = _____ ÷ 2 = [_____ ft.]

B **Average width of flow space**

Up river _____ ft. + Down river _____ ft. = _____ ÷ 2 = [_____ ft.]

C **Average depth of flow space**

1._____ in. + 2._____ in. + 3._____ in. + 4._____ in. + 5._____ in. = [_____ in.]

[_____ in.] ÷ 5 = _____ in. ÷ 12 in. = [_____ ft.]

D **Average rate of flow through flow space**

Ball 1

1._____ sec. + 2._____ sec. + 3._____ sec. + 4._____ sec. + 5._____ sec. = [_____ sec.]

Ball 2

1._____ sec. + 2._____ sec. + 3._____ sec. + 4._____ sec. + 5._____ sec. = [_____ sec.]

[**Ball 1** _____ sec.] + [**Ball 2** _____ sec.] ÷ 10 = [_____ sec.]

Equation: _____ ft. x _____ ft. x _____ ft. ÷ _____ sec. = [_____ cubic ft./sec.]

A B C D X

How To Calculate Water Flow (Example)

(A) - Average length of flow space
(B) - Average width of flow space
(C) - Average depth of flow space
(D) - Time of flow through space

Solving for (X) = water flow rate in cubic ft./sec.

Equation: (A) x (B) x (C) ÷ (D) = (X)

(A) Average length of flow space

North bank 80 ft. + South bank 95 ft. = 175 ÷ 2 = **87.5 ft.**

(B) Average width of flow space

Up river 50 ft. + Down river 55 ft. = 105 ÷ 2 = **52.5 ft.**

(C) Average depth of flow space

1. 46 in. + 2. 35 in. + 3. 24 in. + 4. 32 in. + 5. 18 in. = **155 in.**

155 in. ÷ 5 = 31 in. ÷ 12 in. = **2.58 ft.**

(D) Average rate of flow through flow space

Ball 1

1. 20 sec. + 2. 22 sec. + 3. 27 sec. + 4. 32 sec. + 5. 30 sec. = **131 sec.**

Ball 2

1. 21 sec. + 2. 26 sec. + 3. 32 sec. + 4. 29 sec. + 5. 27 sec. = **135 sec.**

Ball 1 131 sec. + **Ball 2** 135 sec. ÷ 10 = **26.6 sec.**

Equation: 87.5 ft. (A) x 52.5 ft. (B) x 2.58 ft. (C) ÷ 26.6 sec. (D) = **445.6 cubic ft./sec.** (X)

On-Site Activity #2 — Riparian Ramble

Major Concepts:
- Water quality
- Watershed
- Stewardship

Learning Skills:
- Observing, communicating, inferring
- Collecting, analyzing and evaluating information
- Map reading

Subject Areas:
- Science
- English Language Arts
- Social Studies
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Wagoner Road Access, New River Nature Trail

Group Size: 30 or less, preferably in groups of 10 or less with a minimum of one adult leader per group.

Time: 1 - 1 1/2 hours

Appropriate season: spring, summer, fall

Special considerations:
- It is strongly recommended that leaders scout the trail ahead of time to become familiar with recommended stops and to recognize potential hazards (i.e. slippery rocks, cliffs, poison ivy, etc.)
- Leaders should carry a first aid kit, water, whistle, and a throw rope.

Crayfish

Materials:
Provided by park:
Per each adult leader: one leader's kit containing a throw rope and whistle, topographic map, *Pond Life* guide, Native American artifacts, trail map
Provided by the school:
Per class: one first aid kit and water bottle
Per adult leader: one copy of the Riparian Ramble Teacher's Guide

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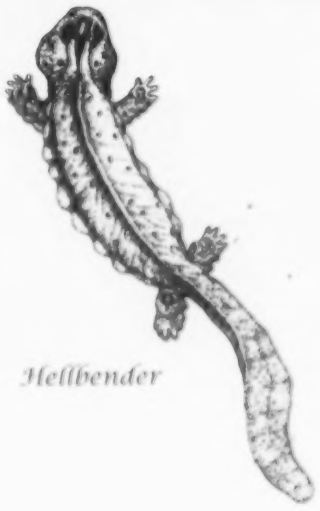
Objectives:

- Make field observations and inferences regarding past land use along the New River.
- Compare Native American use of the New River Basin with that of the European settlers.
- Use a topographic map to find elevation and flood levels in the field.
- Explain the designation "scenic river" and how it relates to development in the watershed today.



Hellbender

Educator's Information

In this activity, educators will guide students along the New River Nature Trail, a one-mile loop trail. The trail may be reached from the parking lot by following the directional signs to "camping and nature trail." The New River Nature Trail goes through the woods and along the banks of the New River. The purpose of the hike is to provide students with a series of hands-on activities that will help them appreciate the natural and cultural history of the area. A brief overview of the hike follows.

- **Stop #1**- Students will observe the remains of an old farmhouse and make inferences as to why the house was constructed in that location.

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• **Stop #2** - Students will examine an old cattle feed box sitting in its original location, now surrounded by forest. From their observations, they will infer that the forest was once a field and discuss the **succession** of plant life that has occurred through the years.

• **Stop #3** - (located beside an old logging road) Here, students will be encouraged to use their skills of observing and inferring to determine when and how the area was logged, and what impact this logging may have had on the New River.

• **Stop #4** - Students will observe some wildflowers, then learn how Native Americans and European settlers used these plants.

• **Stop #5** - Students will use visual observations to locate stop #5 on a **topographic** map. They will see how the river **meanders** and discuss geologic theories about the age of the New River.

• **Stop #6** - Students will examine the **soil** and see how it differs from the soil at higher elevations along the trail. They will infer that the soil was carried there by floods, look for evidence of recent flooding, and locate the levels of the 40-, 100-, and 500-year floods on the topographic map.

• **Stop #7** - Students will observe an area that may have been used as a fishing spot by the Cherokee Indians, examine arrowheads and other artifacts, and learn of the Native American lifestyle through a guided imagery exercise.

• **Stop #8** - Students will view the site of an old ford and understand how the island was formed.

• **Stop #9** - Students will learn how the New River was saved from being dammed and how construction of a dam would have changed the area. They will also discuss the state and federal "scenic river" designation and how it relates to development in the **watershed** today.

Instructions:

1. To ensure the success of this on-site activity, we recommend you conduct pre-visit activities #2 and #3 in this EELE.

2. Before bringing students to the park, study the **Riparian** Ramble Teacher's Guide. Visit the park to scout the trail yourself. Ideally, this should be done at least one week prior to your class' visit and at the same time of day. This will help you become familiar with the exact locations of stops described in the Riparian Ramble Teacher's Guide and potential trail hazards such as slippery areas, steep banks, etc. You could also look for additional stops to view plants and wildlife. If you are unfamiliar with **aquatic** environments, you will need to carry a field guide or request assistance from park staff. An excellent all-purpose guide is *Pond Life* by the Golden Press. (See Reid and Zim in Reference section.) Remember that it's less important to identify the specific name of a plant or

Louisiana waterthrush as it walks and bobs along the water's edge looking for aquatic insects.

animal than it is to appreciate its place in nature (**ecology**).

3. Divide the class into smaller groups of ten students or less. Provide one adult leader per small group. Give each leader a copy of the Riparian Ramble Teacher's Guide prior to the hike.

4. During the hike, one of the group leaders should carry the first aid kit and water bottle. All the leaders should carry a throw rope, whistle, map of the area, and a copy of *Pond Life*. Each student should have a "buddy" in his/her group. Each pair of students will be given a small litter bag at the park to help with trail clean up.

5. Begin the hike with a brief introduction during which you will cover topic, trail distance, time, difficulty, and special rules. Here are some rules to teach your students:

a. Stay on the trail until told otherwise.

b. Watch for roots, stumps, sloped walking areas, and other hazards. Running is not allowed on the trail.

c. Do not pick, injure or destroy any plants or animals in the park. (The purpose of the state parks system is to preserve and protect our natural resources.)

d. Being quiet will help you see more wildlife.

e. The adult leader should always be at the front of the group.

f. When picking up litter along the trail, do not touch broken glass, twisted metal or fishing line containing hooks.

6. When conducting the hike, start each small group at a different stop along the trail so that the groups do not get too close to one another. Make sure all the leaders know the amount of time that they have to conduct the hike and visit all the stops. All groups should end their hike at Stop 9. Remind the leaders that when pausing to view an interesting object along the trail, they should lead their group halfway beyond the object so that all will have a good view. Three loud blasts on the whistle always indicates an emergency. Be sure to review emergency procedures with all the leaders.

Assessment:

Back in the classroom, discuss the following questions with the students or ask them to write their responses.

A. What types of past land use did you observe on your hike along the New River? Give the evidence (actual observations) that points to each type of land use.

Answers:

1. Farming (ruins of old farmhouse, non-native plants, cattle feed box, old field succession)

Louisiana Waterthrush

2. Logging (old road bed, lack of presence of huge virgin timber)

3. Hunting (Native American artifacts)

B. Compare the Native American use of the area with that of European settlers.

Answer: Archaeological evidence indicates that Native Americans were primarily hunters/gatherers with no permanent settlements here. European settlers used the area for farming, raising livestock and logging, in addition to hunting and gathering **native** animals and plants.

C. If possible show your students topo maps of other river basins and ask them to locate the 100-year flood levels. Discuss: What can change the flood level along a river?

Answer: Activities within the river basin such as logging, farming and development can increase runoff which can, in turn, expand flood levels marked on a map. For this reason, field observations should be used along with map designations when attempting to locate actual flood levels of a river.

D. On both the federal and state levels, a 26.5-mile stretch of the New River is designated a "Scenic River." What does this mean? Does this designation protect the water quality? Why or why not?

Answer: The federal and state "Scenic River" designations mean this section of river will always be free flowing and never dammed. They also protect this section from any federally funded project that might impact water quality or recreation.

Neither of these designations does anything to protect water quality outside this stretch of scenic river, however. Remember that activities occurring anywhere within a watershed or river basin can impact the water quality of the entire river.

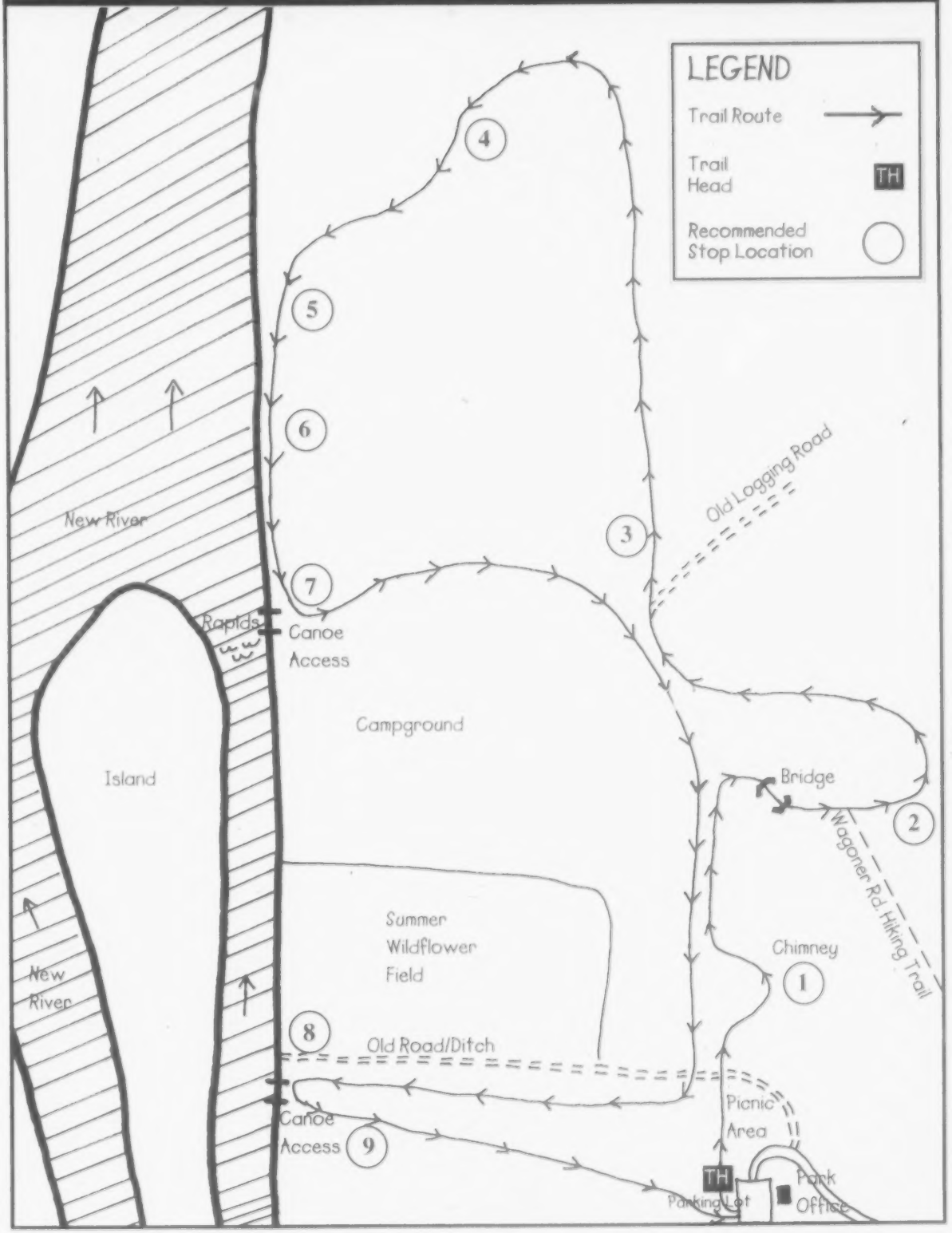
Extensions:

1. The North Carolina Division of Water Quality has classified the 26.5-mile stretch of the New River inside the park as an **Outstanding Resource Water** or ORW. The ORW classification is given only to unique and special waters which have excellent water quality and some special resource value, such as a diversity of plant and animal species. The ORW classification was given to this section of river as a means of protecting it from practices that might harm the water quality. Have students research how the Division of Water Quality classifies surface waters in our state and how the ORW designation protects water quality in the New River. For more information, contact the Division of Water Quality, P.O. Box 29535, Raleigh, NC 27626-0535; or see their Web site under the North Carolina Department of Environment and Natural Resources.

2. Have students participate in the *Aquatic Project Wild* activity, "To Dam or Not to Dam," where they role-play individuals representing differing perspectives and concerns related to the construction of a dam on a river. See References under Council for Environmental Education.

3. Use the Native American legend at the end of this activity. Discuss other Native American legends about water. What do these legends tell you about the people who created them? Create your own legend about a river.

Riparian Ramble Trail Map



Stop 1: Chimney — Remnants of the Past

Here are some possible questions to encourage students to observe and make inferences:

1. Why do you think there is an old chimney sitting in this open area?

Answer: An old farmhouse used to be here; all that remains is the chimney.

2. Look around you. Why do you think the builder of the farmhouse chose this location?

Answer: There was an abundance of **water** for the people, crops and livestock. Many places along creek and river bottoms were relatively flat, and therefore easier to farm. **Soil** fertility is typically high along a river due to its flooding and depositing soil from upstream. The river is also a source of water for irrigation.

3. Even if there were no chimney here, how could we tell an old farmhouse once stood here?

Answer: The presence of non-native plants that you don't normally find growing wild in the area such as lilac, yucca, a white poplar tree. They where probably planted around the perimeter of the house.

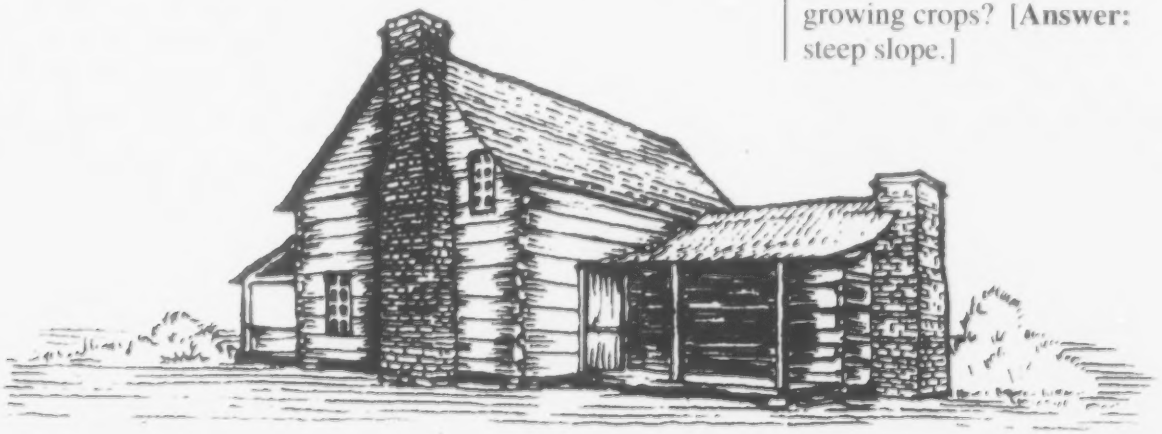
Stop 2: Cattle Box/ Succession (At Nature Trail Post #4)

Script — What in the world do you think this old rusty box is doing here in the forest? What is it? [*Pause to allow students to examine the box and verbalize their observations.*] If you look closely at the side of the box what does it say? It says something about cattle, doesn't it? This is actually an old cattle feed box and it is sitting in its original location.

It seems odd that a cattle feed box would be in the woods. What could this

mean? Look around at the trees and plants. The trees really aren't that big are they? What can we infer from our observations? [*Pause for students to report observations and inferences.*]

At one time, this area was probably an open field with cattle grazing on it. After the field was abandoned (maybe because the farmer could no longer make a living and had to move on, or because the state bought the land for a park), changes in the plant life began to occur. Weeds were the first things to come up, then shrubs, and then small trees. This process is called **succession**. Why do you suppose this land was used for pasture and not for growing crops? [**Answer:** steep slope.]



Stop 3: Old Logging Road (Near Nature Trail Post #10)

Script — What is that long, narrow flat place going up the hillside? [*Pause for students to respond.*] It is probably the old road bed for a logging road. Between 1890 and 1920, the southeastern slopes of the North Carolina mountains were stripped of about every locust, oak, maple, hickory and buckeye large enough to be used for lumber. The trees were cut one at a time, grouped together in bundles of three or four, and hauled down the hillsides by ox and ass, and later, by steam wenches. The trees were loaded onto trains, hauled to town, and used for building materials. Narrow gauge railways (with rails closer together than the tracks we see today) were used on the mountainsides specifically for logging operations. After the areas were cleared, the loggers ripped up the tracks and moved them to another site. Often, the ground was left muddy and bare.

What affect to you think this type of logging might have had on the river? [*Pause for student response.*] During heavy rains, loose **sediment** may have washed into the river, harming fish and other **aquatic** life. Timbering also brought about a change in Ashe County by opening up much of the area as pasture land. Timbering is still important to this area's economy — many trees are being planted adjacent to the river for timber and Christmas trees.

Fraser fir

Stop 4: Wildflower Uses and Folklore (Near Nature Trail Post #14)

Script — Look at all the vegetation on the forest floor around us. In the spring and summer, hundreds of different flowers grow here, such as Jack-in-the pulpit, bloodroot, and yellow violet. We tend to think of wildflowers as just something pretty to look at, but Native Americans and early European settlers ate these plants or put them to good use. [*Safety warning: children should never eat plants unless they are with an adult who is absolutely certain they are edible.*]

Jack-in-the-Pulpit
(***Arisaema triphyllum***)

This wildflower's name very much describes its bloom. The curved hood, called the spathe, forms the "pulpit," while the club-like spadix resembles "Jack." Native Americans found many dietary uses for this plant. If boiled, the underground tuber can be eaten like a turnip, thus giving it the name "Indian turnip." If uncooked, the tuber causes a burning sensation in the mouth. Native Americans and early settlers took advantage of this quality by grinding it and using it as a substitute for pepper. They also gathered, boiled and ate the glossy red berries that form in late summer and fall. Native Americans used the dried root as medicine for colds and dry coughs.

Folklore: It has been told

Jack-in-the-Pulpit

that when city boys came to visit their country cousins, the country boys would introduce them to the country by giving them a bite of the Jack-in-the-pulpit. At first the plant would taste fine, but after a while the burning sensation would begin and would cause an inflammation of the throat and mouth that would last for hours! (Calcium oxalate crystals in the plant become imbedded in the tissues of the mouth to cause this burning sensation.)

Bloodroot (*Sanguinaria canadensis*)

The delicate flower of the bloodroot lasts a short time and opens only in full sun — before the trees open their leaves and shade the ground. This wildflower was named for the poisonous reddish-orange sap in its roots and stems. The sap was used by Native Americans for paint and dye. Pioneers used a small drop of the sap on a lump of sugar to treat coughs.

Bloodroot

Violets

Violets are high in vitamins A and C and were used in foods and medicines. Traditionally, the flower was mixed with milk for nourishment and used as a facial moisturizer and replenisher. Today, many people still use violets to make jams, jellies, and candy, and as a garnish in salads.

Blue Violet

Stop 5: The Old New River — Topo Map Exercise (Near Nature Trail Post #15)

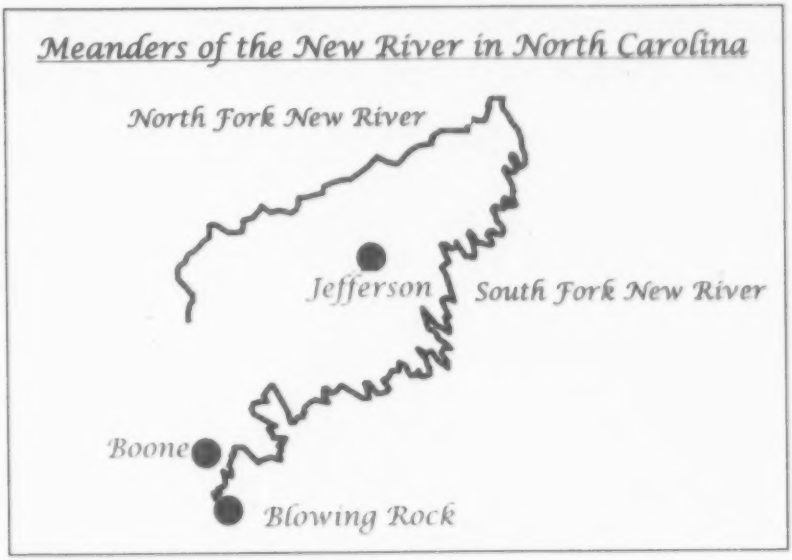
Directions for the leader: If the students did not review topographic maps before visiting the park, the leader may have to explain to the students how to read a **topographic** map. First, see if the students can point to due north (without looking at the map). Use the map to see how close they came. How could this map help if you were lost?

Next, the leader should point out major features of the topographic map such as **contour lines**, symbols for dwellings, numbers indicating elevations, and the fact that there is a 40-foot change in elevation between each contour line. Challenge the students to match landmarks or features they can see around them with those on the topographic map.

Script — Can you find the New River on the map? Try to find our exact location. Look around and use natural features to help you figure it out. See the island way to your left and the bend in the river to your right? Use those. What is the approximate elevation where we're standing? [**Answer:** 2,640 ft.]

Looking at this map, we can see that the New River **meanders** back and forth across the land. Given our location, what would happen if we walked across the river straight over that hill in front of us? [**Answer:** we would run into the New River again.]

Usually, only rivers that flow on flat land are meandering in their course. This leads scientists to theorize that the New River existed before the mountains were formed. They think that about 500 million years ago the area was a broad, gently rolling plain. As the land rose slowly and the mountains formed, the New River kept its course by



cutting down into the land. Although some people have called the New River the "second oldest river in the world," geologists do not have enough evidence to support this statement. The river is probably over 500 million years old, but no one knows its actual age.

Stop 6: The Floods (Near Nature Trail Post #17)

Script — Look down at your feet. How is the soil here by the river different than the soil up on top of the hill? [**Answer:** It is a lighter color and looks finer and more sandy.]

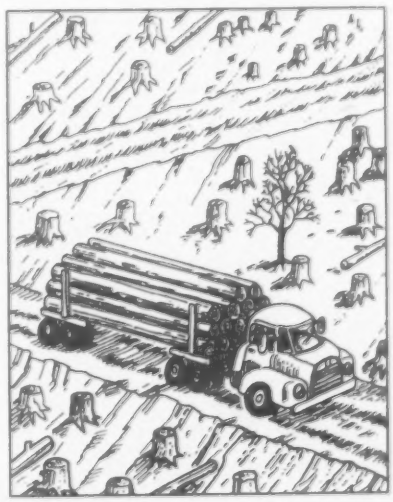
Why do you suppose this is? [**Answer:** The soil present here was washed onto these banks during periods of flooding. It is rich in minerals and excellent for growing crops.]

Have you heard of the 40-year, 100-year, or 500-year floods? Based on past occurrences, scientists predict that every 40 years we will have a flood that brings the water in this river up to a certain level. Every 100 years we'll have a more severe flood, with higher water levels. Every 500 years we'll have a flood that raises the water level even higher, doing considerable damage. Actually, as recently as January of 1995 we had a 40-year flood on the New River bringing the water well above the banks. Look around you. What evidence do you see of flooding? [**Answer:** debris on the banks and in trees, washed away areas, thick deposits of **silt**.]

Look again at the topographic map. The dark lines represent the 100-year and 500-year flood levels. Where would we be right now if this area were experiencing a 100-year flood? [**Answer:** under water!] Using the map, can you point out the 500-year flood level on the hillside?

Do you think these flood levels can change over time? [**Answer:** Yes! If land uses change in the **watershed**, the flood levels will change. For example, if trees are cut and replaced by a shopping center and parking lot, more runoff will occur in the next big rainstorm. People living downstream from this development might find that, although their homes were located above the 40-year flood level last year, they are now inside this flood level and they may get washed out!]

Look at the date on this topo map. The flood levels for certain sections of the New River may have changed since this map was made. If you were buying property near a stream or river, you should not rely on the map alone to tell you about flood levels. You



should do what we are doing today — walk the land and look for evidence of flooding.

Stop 7: Native Americans/Artifacts/ Indian Legend (Canoe Ramp Access Below Campground)

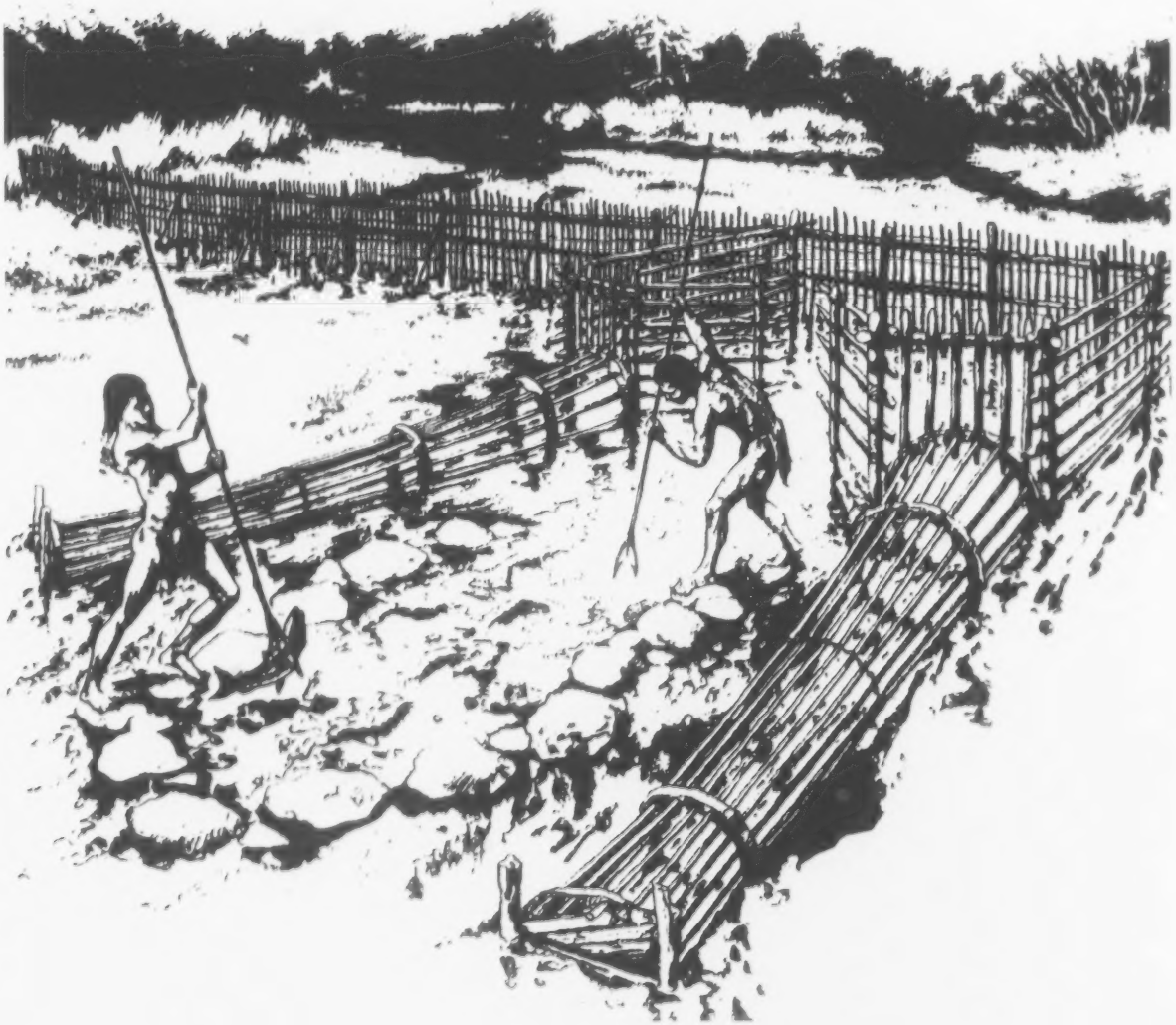
Directions for the Leader: Follow the nature trail past post #17. You will see a Nature Trail sign on your left. Go past the sign to the canoe ramp access steps below the campground.

Script — Archaeological investigations in the New River valley suggest the presence of humans in the region for at least ten thousand years. [*Pause to show artifacts.*] Artifacts such as these arrowheads, pottery shards, and stone axes indicate that the Canawhay Indian tribe occupied the valley during the precolonial period. The valley was a hunting ground for bands of Creek, Shawnee and Cherokee Indians. Their hunting trails led north along the New River to the Ohio River. Rock shelters discovered near the confluence of the river's forks were used by hunters who camped in the bottomlands. The river was a major route of travel for transient hunters, but there were no permanent settlements in the area, perhaps due to more aggressive northern tribes nearby.

During the precolonial period, the New River valley was a land of dense forests, with some open meadows, and an abundance of wildlife including bison, elk, black bear and beaver. The Indians constructed canoes out of hollowed-out sycamore trees. They paddled to different areas along the river to hunt and fish. Their weapons were made of various stones and wood. They wove long narrow baskets from the inner bark of oak trees and used them as fish traps. They would anchor the traps in shallow, swift, rocky areas like this one. [*Pause to show illustration of fish trap on following page.*] The fish would swim over the rocks and into the traps. Due to the current, the fish could not swim back out of the traps.

Native Americans have some very interesting beliefs and legends about nature. Their legends about trees, rivers, animals, mountains and canyons reveal an understanding of the spiritual force of nature and the human being's interconnectedness with it. For example, the Yuma Indians of the southwest call water "mother" and the sun "father." They believe the sun called the earth up from beneath the water. The sun and earth met and kissed, and the sun pulled back to the sky, but the earth remained where it was. Where the earth and sky came apart, the highest points became mountains of hard rock. Yuma is said to mean "sons of the river." The Teton Sioux of the Great Plains believed that certain stones were sacred things and had special powers. The Pawnee Indians, also of the Great Plains, believed the bear got his power from the sun, and that it was centered in his claws. [*Share Native American legend found at the end of activity if time permits.*]

A Native American Fish Trap



Stop 8: The Ford and Island (Canoe Ramp Access at Picnic Area)

Directions for the Leader: Follow the Nature Trail to post #19 and then follow the old road. Go past the old chimney to the picnic area under the apple trees. Turn right and go down to the canoe access steps.

Script — On your right, you see a ditch that is the remains of an old road. The road crossed the river at a ford and went over to the island in front of you. Does everyone know what a ford is? It is a shallow place in a body of water where a crossing can be made on foot. The island across from us was formed when the river lost velocity and dropped some of its load of sediment. The sediment built up against the rocks downstream. The island was stabilized by the trees and plants growing on it. At one time, farmers grew beans and grains on this island.

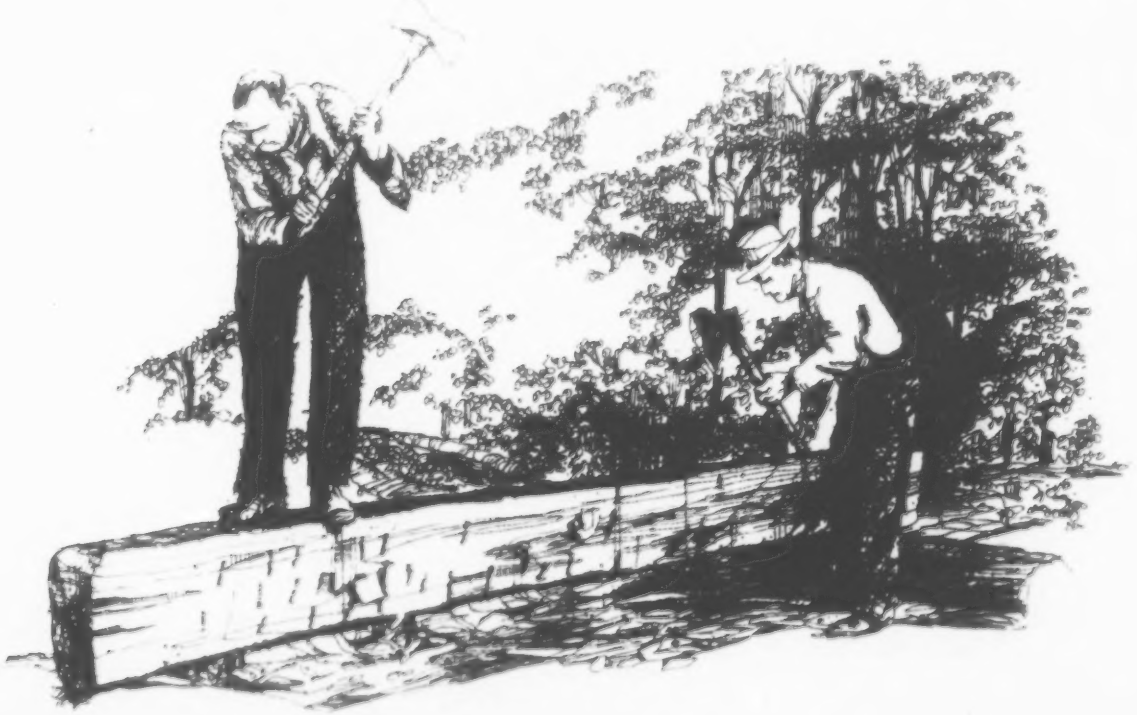
Stop 9: Scenic River Designation/Conclusion (Find Plaque in Field.)

Script — Take a moment to read this plaque. [*Ask a student to read it to the other students.*] This plaque signifies the end of a long struggle to save this section of the river from being dammed. In 1965, Appalachian Power Company applied for a license to build two dams on the river and build reservoirs for water storage. This reservoir would have flooded 42,100 acres of land and nearly 2,500 people would have had to move. Over time opposition to the proposal arose from citizens' groups, and state and federal agencies. On May 26, 1975, the North Carolina General Assembly declared the 26.5-mile stretch of the river from its confluence with Dog Creek to the Virginia state line a State Scenic River. In September 1976, President Ford signed a bill designating this same portion of the New River a Federal Scenic River, thereby prohibiting the construction of the dam and reservoirs. New River State Park was then established along this scenic corridor. If the river had been dammed, you would now be under about ten feet of water!

Crossing a Ford

Where is the water we have seen here today going? Where will it eventually end up? [*Students should remember this if they studied Pre-visit Activity #2 before coming to the park.*] The New River originates from springs near Blowing Rock, NC. It flows through North Carolina, Virginia and West Virginia. In West Virginia the New River merges with the Gauley River to form the Kanawha River. The Kanawha flows into the Ohio River, which then flows into the Mississippi River, which empties into the Gulf of Mexico. This represents a journey of more than 2000 miles and would take approximately 110 days.

To study the New River is to look back in time to primeval eras before people existed, to the days of the Native Americans who used the waterway as an avenue for migration and trade, and to the time of early European settlers who came to farm the land and cut the forests. I hope you have enjoyed our journey back in time. Although the river was not dammed, there are other threats to it today, such as housing developments. The 26.5 mile federal and state Scenic River designation is wonderful, but it will not prevent development. The designation means only that the state manages a quarter-mile or so of the land on either side of this particular stretch of river. The idea is to preserve the natural and cultural character of the river corridor. But a river is far more than its corridor. The watershed of the New River is roughly 750 square miles of land and creeks. And a river is only as good as the water that comes into it. Even with the designation, development can continue in this watershed or **river basin**. What can people do to help preserve the river as it is?



"Koluscap and the Water Monster"

(From the MicMac and Maliseet — Nova Scotia)

Once there was a great drought. The rain stopped falling and the Earth became dry. Finally, the streams themselves stopped flowing. There was a village of people who lived by the side of a stream, and life now became very hard for them. They sent someone upstream to see why the stream had stopped. Before long, the man came back.

"There is a dam across the stream," he said. "It is holding back all the water. There are guards on the dam. They say their chief is keeping all the water for himself."

"Go and beg him for water," said the elders of the village. "Tell him we are dying without water to drink." So the messenger went back again. When he returned, he held a bark cup filled with mud.

"This is all the water their chief will allow us to have," he said.

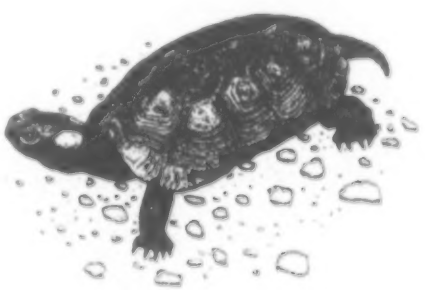
Now the people were angry. They decided to fight. They sent a party of warriors to destroy the dam. But as soon as the warriors came to the dam, a great monster rose out of the water. His mouth was big enough to swallow a moose. His belly was huge and yellow. He grabbed the warriors and crushed them in this long fingers which were like the roots of cedar trees. Only one warrior escaped to come back to the people and tell them what happened.

"We can not fight a monster," the people said. They were not sure what to do. Then one of the old chiefs spoke. "We must pray to Gitchee Manitou," he said. "Perhaps he will pity us and send help." Then they burned tobacco and sent their prayers up to the Creator.

Their prayers were heard. Gitchee Manitou looked down and saw the people were in great trouble. He decided to take pity and help them and he called Koluscap. "Go and help the people," Gitchee Manitou said.

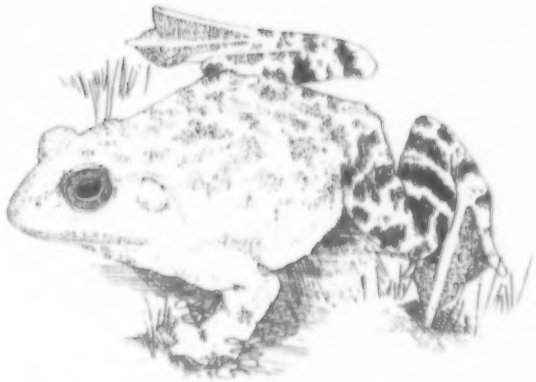
Koluscap then went down to the Earth. He took the shape of a tall warrior, head and shoulders taller than any of the people. Half of his face was painted black and half was painted white. A great eagle perched on his right shoulder and by his side two wolves walked as his dogs, a black wolf and a white wolf. As soon as the people saw him they welcomed him. They thought surely he was someone sent by the Creator to help them.

"We cannot afford you anything to drink," they said. "All the water in the world is kept by the monster and his dam."



"Where is the monster?" Koluscap said, swinging his war club, which was made of the root of a birch tree.

"Up the dry stream bed," they said.



So Koluscap walked up the dry stream bed. As he walked he saw dried up and dead fish and turtles and other water animals. Soon he came to the dam, which stretched between two hills. "I have come for water," he said to the guards on top of the dam.

"GIVE HIM NONE, GIVE HIM NONE!" said a big voice from the other side of the dam. So the guards did not give him water.

Again Koluscap asked and again the big voice answered. Four times he made his request, and on the fourth request, Koluscap was thrown a bark cup half-full of filthy water.

Then Koluscap grew angry. He stomped his foot and the dam began to crack. He stomped his foot again and he began to grow taller and taller. Now Koluscap was taller than the dam, taller even than the monster who sat in the deep water. Koluscap's club was now bigger than a great pine tree. He struck the dam with his club and the dam burst open and the water flowed out. Then he reached down and grabbed the water monster. It tried to fight back, but Koluscap was too powerful. With one giant hand Koluscap squeezed the water monster and its eyes bulged out and its back grew bent. He rubbed it with his other hand and it grew smaller and smaller.

"Now," Koluscap said, "no longer will you keep others from having water. Now you'll just be a bullfrog. But I will take pity on you and you can live in this water from now on." Then Koluscap threw the water monster back into the stream. To this day, even though he hides from everyone because Koluscap frightened him so much, you may still hear the bull frog saying, "Give Him None, Give Him None."

The water flowed past the village. Some of the people were so happy to see the water that they jumped into the stream. They dove so deep and stayed so long that they became fish and water creatures themselves. They still live in that river today, sharing the water which no one person can ever own.

Post-Visit Activity #1 — Judge and Jury

Curriculum Objectives:
Grade 7
- Theater Arts: display initiative, participate in creative drama
- Visual Arts: develop positive attitudes
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: being responsible in a group develop an awareness of alternative points of view
- Science: interactions of people and the environment
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Grade 8
- Theater Arts: participate in creating and producing simple, original scripts
- Visual Arts: develop positive attitudes
- Communications Skills: listening, visual, reading and vocabulary comprehension, speaking techniques
- Science: science and its relationship to human endeavors
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Location:
Classroom, with chairs arranged to represent a courtroom

Group Size:
One to several classes

Estimated Time: 45 minutes

Appropriate Season: Any

Materials:
Provided by the educator: two clipboards with paper, two pencils, enough copies of background material for entire class

Special Considerations:
This role playing activity is to be used as a learning tool, designed to demonstrate the valid concerns that exist on many sides of various land use questions. The purpose is not to cast preservationists as "good guys" and developers as "bad guys." It is not intended to be taken too seriously nor to place any student, who may have personal affiliations with the groups involved, in an awkward situation.

Major Concepts:
- Stewardship
- Cultural conflicts
- Land use changes

Objectives:
- Present rational points in a debate over land use.
- List three reasons for preserving and protecting the river corridor.
- List three reasons for developing all or part of the river corridor.

Instructions:

1. Have the students read the background material "Introduction to New River State Park" on page 1.2 and the Student's Information for this activity to acquaint themselves with the issues.

If possible you might have the students read *The New River Controversy* by Thomas J. Schoenbaum.

2. Have the students choose three judges from their peers who will "try the case" to decide how land along the New River should be used.

3. Divide the remaining students into two equal groups.

Situation #1: Appalachian Power Company versus Conservation Coalition.

4. Appoint one group to be the Appalachian Power Company and the other to be the Conservation Coalition.

5. Have each group appoint a recorder, who will write down the issues important to the group, and a lawyer, who will act as the group's spokesperson.

6. Give each recorder a clipboard, paper and pencil.

7. The two groups should separate and discuss among themselves why the New River should or should not be dammed.

8. After 10 minutes of discussion, the lawyer from each group should present their group's case regarding how the land should be used to the three judges.

9. Give the judges three to five minutes to deliberate, then have them deliver their verdict to the class with the reasons for their decision.

10. After the verdict has been given, lead a discussion on why the river is still free-flowing and not dammed.

11. Have the students choose three new judges and have the old judges join the groups.

Situation #2: Developers versus Conservation Coalition

12. Let the Appalachian Power Company become the new Conservation Coalition and let the old Conservation Coalition become the developers.

13. The groups will again separate and list reasons why their vision of land use along the New River should be the one that is implemented.

14. Follow steps 4 through 9 again except now the question is whether there should be development along the New River State Park's 26.5 mile river corridor.

15. After the judges give their verdict, lead a discussion on the land use conflicts along the New River today.

Suggested Extensions:

1. Have the class discuss the land owned by the park. What are their ideas on the state's right to buy property even from people unwilling to sell? (The class may want to use this as a role playing situation as well.)

2. Have the class role-play that they are Ashe County land use planners and come up with a development plan for the New River.

3. Have the class attend a land use planning meeting and/or a county commission meeting where land use plans are decided.

4. Organize a "Stream Watch" group in your community. Stream Watch groups "adopt" a waterway, or portion of one, and act on its behalf. They take care of the waterway by monitoring water quality, providing educational programs, removing litter, etc. For more information on Stream Watch, contact:

Stream Watch Coordinator
Division of Water Resources
N.C. Department of
Environment, Health and
Natural Resources
P.O. Box 27687
Raleigh, NC 27611
Tel (919) 733-4064

5. Collect newspaper articles for local water related and land use issues as a current events activity.

6. Learn more about environmental impact statements. Try to obtain actual statements about natural areas in your region from local and state government offices. See what concerns are addressed in these documents.

7. Learn more about private organizations that work to protect natural resources. Examples include:

The North Carolina Environmental Defense Fund
128 E. Hargett St., Suite #202
Raleigh, NC 27601

The North Carolina Nature Conservancy
Carr Mill Mall, Suite 223
Carrboro, NC 27510

National Committee for the New River
P. O. Box 1107
Jefferson, NC 28640

Trout Unlimited
800 Follin Lane
Vienna, VA 22180-4959

North Carolina Wildlife Federation
P. O. Box 10626
Raleigh, NC 27605
Tel. 919-833-1923

8. Find out about zoning laws and land use regulations in your area by contacting the following:

City/County:
Ashe County Planning Board
Jefferson, NC 28640
Tel. 910-246-8841

State:
Winston-Salem Regional Office
Division of Community Assistance - Planner
8025 North Point Blvd.
Winston-Salem, NC 27106-3256

Region D -
Council of Government
Planning Specialist
P. O. Box 1820
Boone, NC 28607
Tel. 704-265-5434

Would the plan your group proposed for the river watershed be allowed in your community?

9. Send a representative sample of the students' land use plans to the park. (We would appreciate the feedback.)

10. Write to the Ashe County Planning Board about any concerns you have with the water quality of the New River's watersheds.

Ashe County Planning Board
Jefferson, NC 28640
Tel. 910-246-8841

Student's Information

Every human use of land in the New River **watershed** has a positive or negative effect, not only on the New River, but on the **water**, wildlife and people downstream, all the way to the Gulf of Mexico. What we do with land is a reflection of our priorities, lifestyles and conservation ethics. The search for a modern day "good life" and all of its conveniences produces mixed results for plants, animals, **water quality** and people in the New River watershed. Some people see our natural resources as little more than raw material for human use. Others believe that a natural environment is to be preserved completely undamaged by humans and their lifestyles. Still others believe there should be a balance between development and protection of our resources. Very real differences of opinion regarding these issues exist between well meaning people.

Given the extensive impact humans have had and continue to have on the earth, a major challenge we now face is how to act more responsibly. We must develop the awareness, knowledge, skills and commitment necessary to encourage others to act more responsibly when it comes to taking care of watersheds and the remaining natural areas. We must develop the necessary understanding to restore areas where human disturbance has existed for centuries.

At the core of land use issues is the concept of growth. Growth in natural systems has inherent limitations, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and continued survival. This means that the vitality of natural systems is expressed by their ability to be self-regulating. This capacity for self-regulation makes it possible for all natural members of an **ecosystem** to live in harmony. All life forms of any ecosystem must be considered. The **macroinvertebrates** in the water

are just as necessary to a **habitat** as the plants and fish. It is this natural, dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb. Human activities often go beyond the natural limits of an ecosystem.

The New River area is growing rapidly. People are seeking undeveloped land along the river to build homes for retirement and for vacation homes. Development, however, often conflicts with trying to protect the river's water quality, the plants and animals that live in and around the river and preservation of the area's natural beauty. This is where different people have different ideas about how to best use the land and water from New River and still ensure that the river remains an **outstanding resource water**.

Think back to your visit to New River State Park. We know the New River provides water to many towns and cities which is used in a variety of ways, including water for drinking, for industry and sewage treatment. Many different forms of recreation are enjoyed on and around the New River, including fishing, canoeing, tubing, hiking and nature study. The river is also home to a wide variety of plants and animals.

Soon water will be taken out of the New River to provide drinking water for West Jefferson and Jefferson. We know that water is taken from the New River for irrigation. Many different forms of recreation are enjoyed in the New River watershed. The New River and its watershed provide crucial habitat for many plant and animal species. The Kanawha Minnow and Kanawha Darter are two animals that are endemic to the New River watershed. Endemic means they are found in these watersheds and nowhere else on earth!

Humans have the ability to import energy sources that allow a system to exceed its natural limits–or to remove energy sources that are necessary for a system to stay in balance. For example, people can dam rivers to make lakes which provide power and irrigation. Water from New River can be used in factories, farms, mills and other industries that need large amounts of water to produce certain products. All of these activities affect the life in and around the New River.

So how do we make land use decisions that will benefit the local economy and still protect our natural resources?

The following activity is designed to give you an understanding of how difficult the decision making process can be.

The New River area of northwest North Carolina and southwest Virginia was used as a hunting ground by Native Americans when the first European settlers arrived in the late 1600's. The early settlers were from Virginia. They established an independent way of life and farmed the mountain valleys. Many of the farms in the area have been in the same family for over 200 years.

In the 1960's the Appalachian Power Company proposed building two dams on the New River as a source of recreation and hydroelectric power. Opposition to this plan came from a coalition of groups such as farmers, fishermen and canoeists who wanted to keep the river as it was.

The conflict from these opposing points of view came to an end when the coalition succeeded in having a 26.5 mile section of the New River established as a component of the National Wild and Scenic River system.

Conflict over land use along the New River continues today. This time it is between conservation groups who want to preserve the landscape and its traditional uses, and developers who want to build new homes along the designated Wild and Scenic section of the New River.

Post-Visit Activity #2 New Development?

Major Concepts:
- River basin
- Water quality
- Land use planning
- Resource Management
- Stewardship

Learning Skills:
- Observing, predicting, communicating
- Decision-making, participating effectively in civic affairs
- Responding critically and creatively to environmental problems

Subject Areas:
- Science
- Social Studies
- English Language Arts
- See Activity Summary for a Correlation with DPI objectives in these subject areas.

Location: classroom

Group Size: 20 - 30 students

Time: One to three 45-minute periods

Appropriate Season: any

Materials:
Provided by educator:
Per student: one copy of Student's Information and Special Species Fact Sheet.
Per group: scissors; masking tape; paste or glue; paper; one copy each of Legend and Land Use Cutouts, Topo Map of the South Fork of the New River, and New River to the Gulf of Mexico

Credits: "Dragonfly Pond." *Project WILD Aquatic Education Activity Guide* — 1987,1992. Council for Environmental Education. Adapted with permission from Project WILD. In North Carolina, Project WILD is part of the N.C. WILD environmental education program. For information about N.C. WILD, contact the N.C. Wildlife Resources Commission, Division of Conservation Education, 512 N. Salisbury Street, Raleigh, NC 27604-1188.

Objectives:
- Name two species in the New River Basin that are listed as endangered, threatened or special concern.
- Define endemic and list one example of an endemic species in the New River Basin.
- Predict positive and negative effects of at least five potential land uses on the South Fork-New River watershed.
- Balance the need to protect water quality with economic and other concerns while working with a group to arrange land use cutouts on a watershed map.
- Describe at least three ways that individuals can contribute to improving water quality in their watershed or river basin.

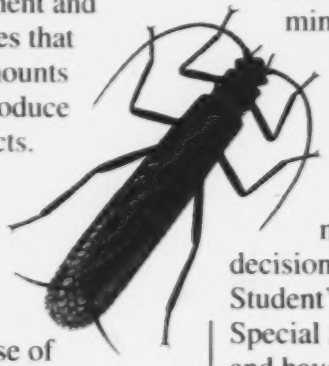
Educator's Information:

Every human use of land in the New River Basin has a positive or negative effect not only on the New River, but on the **water**, wildlife and people from here to the Gulf of Mexico. What we do with land is a reflection of our priorities and lifestyles. The search for a modern day "good life" and all of its conveniences produces mixed results for plants, animals, **water quality** and people in the **river basin**. Some people see our natural resources as little more than raw material for human use. Others believe that the natural environment is to be preserved without regard for human needs. Still others yearn for a balance between development and protecting our resources. Very real differences of opinion regarding these issues exist between well-meaning people.

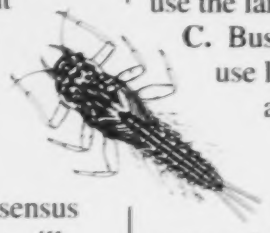
At the core of land use issues is the concept of growth. Growth in natural systems has inherent limits, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and continued survival. This means that the vitality of natural systems is expressed by their ability to

be self-regulating. This capacity for self-regulation makes it possible for all natural members of an **ecosystem** to live in harmony. All life forms of any ecosystem should be considered. The **macro-invertebrates** in the water are just as necessary to a **habitat** as the plants and fish. It is this natural dynamic balance,with all its inherent and essential parts, that much of human land use has tended to disturb.

Human activities often go beyond the natural limits of a setting. Humans have the ability to import energy sources that allow a system to exceed its natural limits — or to remove energy sources that are necessary for a system to stay in balance. For example, people can dam rivers to provide power, drinking water and irrigation. Water from the river can be used in factories, mills, sewage treatment and other industries that need large amounts of water to produce certain products. All of these activities affect life in the New River Basin.



The purpose of this activity is to encourage students to wrestle with development, local economy, and **stewardship** of natural resources. The students will use the South Fork - New River **watershed** as a microcosm of environmental **concerns** in making management decisions. They will contend with the arrangement of overlapping and conflicting land uses in an effort to protect the water quality. When the students reach a consensus about land uses, they will discuss how their arrangement of land uses may affect the river downstream. The activity ends with the idea that the planet is, in fact, a single interconnected water system.



Instructions:

1. Prepare photocopies as described in the Materials section. Explain the activity. Tell the students that they will work together to arrange the pattern of land use within the New River watershed so that the impact on the water quality is minimized. Remind them that some of the land uses are conflicting and they will have to make some tough management decisions. Pass out the Student's Information and Special Species Fact Sheet and have the students read them.

2. Divide the class into teams of three to five, with each team representing one of the interest groups. Students will stay in these groups until the end of the activity. Interest groups are:

A. Residents — people who want to live there.

B. Farmers — want to use the land to raise food.

C. Businesses — want to use land for commerce and growth.

D. State park — wants to preserve and protect the watershed for plants and wildlife, recreation, drinking water and historic sites.

E. Highway department — wants to build a bypass road to ease traffic congestion in town.

F. Textile factory — wants to construct a huge factory that would provide 500 jobs and boost local economy.

G. School representatives — want to build a new school to accommodate more students due to rapid growth of the town.

H. Hospital representatives — propose building a new hospital to service the community in the future because of expected growth and development in the area.

I. County and state representatives — believe it is essential to have a bigger landfill and a newer, more efficient wastewater treatment plant.

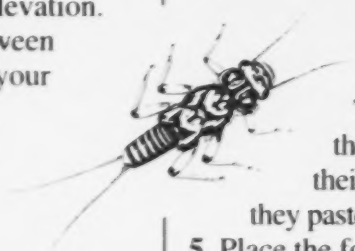
3. Pass out the Topo Map of the South Fork of the New River. Read the following text to the students:

"You will be using a simplified enlargement of a **topographic** map of a section of the South Fork of the New River. Topographic is derived from the Greek words *topos*, meaning place, and *graphein*, meaning to write or draw. Thus, a topographic (topo) map is a drawing or picture of a place. One feature on a topo map is **contour lines**. Contour lines are thin lines that indicate the contour of the land and its elevation. The distance between contour lines on your map is 10 feet. Where the lines are very close together, the terrain is steep. Level terrain is indicated by contour lines that are farther apart. The steepness of the terrain will dictate what types of land uses can occur. For example, you would not put a landfill on a steep ridge. A legend explaining other map symbols is included on the Legend and Land Use Cutouts page."

Tell your students to spend some time in their groups discussing features and symbols on the topo map. Practice locating ridges, summits, rivers, highways, etc. Then read the following text aloud:

"Notice that there are four **species** of animals and one plant species on the map where they might naturally occur. These species have special habitat requirements and most are protected by law. The purpose of placing these on the topo is to make the decisions more realistic. These species are described on the Special Species Fact Sheet."

4. Pass out the Legend and Land Use Cutouts sheet and the Topo Map of the South Fork of the New River. Have the students cut out the land use pieces. When they fasten the cutouts to their topo map, suggest that they use small loops of tape. This will allow them to change their minds before they paste them down.



5. Place the following rules on the chalkboard:

- all land use cutouts must be used; the cutouts may be cut smaller
- cutouts may touch, but may not overlap
- no cutout, except for the state park, can touch or cover a "Special Species" circle
- vegetable farm and landfill must be on relatively level land
- both textile factory and wastewater treatment plant must touch the river
- no cutout can touch or cover an existing building

6. After the students have cut out the necessary materials and are ready to make land use decisions, have them create a list of pros and cons for each land use. Guide the class discussion so the consequences of each land use are considered. Record these on the chalkboard.

7. Have the students work in their groups long enough to begin to seriously grapple with the challenge.

8. Invite each group to display and describe their work in progress. Encourage discussion of their choices. In the discussions, emphasize that:

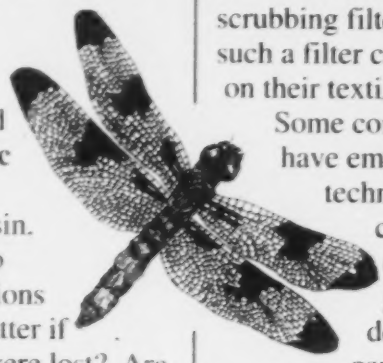
- no land use can be excluded
- wildlife habitat must be preserved
- everyone within their small group must agree

Discuss how their plans will impact the various interest groups. Look for the consequences of their proposed land use plans. Be firm about this being a very difficult set of choices. Remind them that for certain habitats this is a "no-win" situation in many ways. The best that can be hoped for is that the land use plans will minimize the threats to the river and the special plants and animals.

Assessment:

1. Display all the final land use plans for everyone to see and discuss. Analyze and discuss the merits of each approach. Point out that although there are no perfect solutions, the damage to the New River can be minimized.

2. Review information about protected and/or **endemic** species in the New River Basin. Ask students to give their opinions — would it matter if these species were lost? Are some more important than others? Explain.



3. Pass out the New River to the Gulf of Mexico sheet. Choose one of the groups' land use plans and connect their plan to the New River to the Gulf of Mexico map. Then, ask the students to brainstorm possible positive and negative effects that this land use plan could have on the water quality and people downstream. For example, if this group represented the textile factory, you could ask about the effluent. How will it be treated? Where? By whom? Where will it go? What effect will it have on water quality?

4. Ask the students to look again at all of the land uses in this activity. What can people, who are responsible for these various land uses, do to minimize the damage to water quality and the special species? End the activity with a discussion of solutions, rather than problems. For example, some industries have developed new technology that allows them to remove harmful waste using a scrubbing filter. Maybe such a filter could be used on their textile factory. Some communities have employed new technology to collect methane (a common gas generated by decomposing garbage) and have used it as a fuel source.

5. Ask students to create a list of things they personally can do to begin to improve water quality and reduce the potentially damaging effects of their own lifestyles on downstream habitats. If possible, invite them to report periodically throughout the school year on their progress in carrying out these new practices. Discuss with them the concept that all the waters of the planet are, in fact, part of an interconnected water system.

Extensions:

1. Prepare a travel brochure describing tourist attractions, natural beauty and quality of life in the New River Basin.

2. Collect newspaper articles for local water and land use issues as a current events activity.

3. Learn more about the Basinwide Management approach used by the North Carolina Division of Water Quality —(919) 733-5083.

4. Find out about zoning laws and land use regulations in your area. Would the plans proposed by your students in this activity for the South Fork - New River actually be allowed in your community?

5. Send a representative sample of the students' land use plans to the park. (We would appreciate the feedback.)

Student's Information:

The New **River Basin** in North Carolina is famous for small town friendliness, clean air, low crime, rural beauty, and last but not least, the ancient New River. Long protected by her mountain walls from excessive development, the New River has become, in recent decades, one of the last sites of tranquility in the eastern United States.

But the scenery is changing. The national scarcity of **water** and rural land, along with the abandonment of many local farms, has made the land surrounding the New River attractive to developers. More and more farms are being turned into subdivisions and shopping centers. Homeowners see the rural countryside as an escape from their urban lifestyles; developers see it as a wonderful business opportunity; and government planners see the land as something to use to help the local economy by increasing the tax base and creating new jobs. This is understandable, but sometimes development conflicts with protecting the river and the plant and animal **species** living in the **watershed**. This is where different people have different ideas about how to best use the land and water from the New River and still ensure that the New River is scenic and clean.

Think back to your visit to the New River State Park. We know that most of the water users throughout the New River Basin, including industry, agriculture and the watershed's nearly 54,000 residents, rely on the surface water for basic needs such as drinking water, water supply for other uses, and/or disposal of treated wastewater. In addition, many businesses and residents of the New River Basin rely directly or indirectly on the 825 miles of river, including 575 miles of trout streams, to meet their recreational needs and to earn a living. Tourism and resort development, along with water-oriented businesses such as canoeing and trout fishing are just two examples.

The New River and its watershed provide crucial **habitat** for many plant and animal species. Four fishes– the New River shiner, Kanawha minnow, Kanawha darter, and Appalachia darter –are **endemic** to the upper New River watershed. Endemic means they are found in this area and nowhere else on earth!

So how do we make land use decisions that will benefit the local economy and still protect our natural resources? The following activity is designed to give you a feeling for how difficult the decision-making process can be.

Special Species Fact Sheet

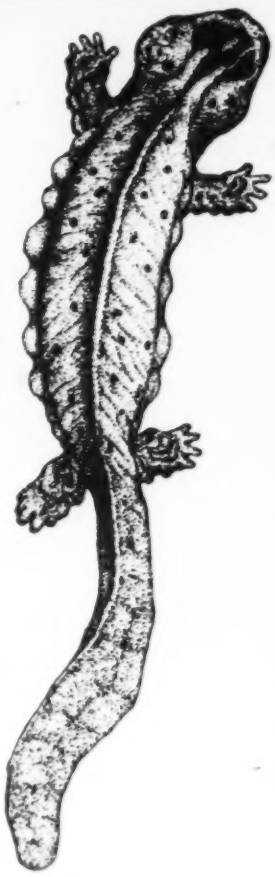
Definitions

Extinct - The complete disappearance or absence of a species. When a species is extinct, it is gone forever with no survivors.

Endangered - A species which is at risk of becoming extinct.

Threatened - A species which is at risk of becoming endangered in the near future.

Special Concern - A species that requires monitoring because it is at risk of becoming threatened in the near future.

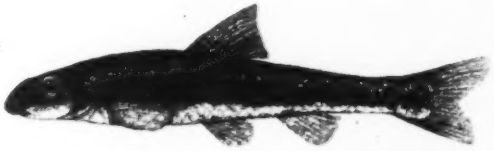


Eastern Hellbender *(Cryptobranchus alleganiensis)*

A huge salamander (12 to 20 inches), also called a mudpuppy or waterdog. Its head is flattened and each side of its body has a wrinkled, fleshy fold of skin. Its coloration varies from gray to yellowish brown to almost black, and it often has scattered dark splotches. The eastern hellbender needs to live in large, clear, fast-flowing streams with plenty of shelter in the form of large rocks, snags, or debris. This salamander is harmless but many fishermen, believing it to be poisonous, will cut their lines and sacrifice their gear rather than unhook it.
Status: Special Concern in the North Carolina mountains.

Kanawha Minnow *(Phenacobius teretulus)*

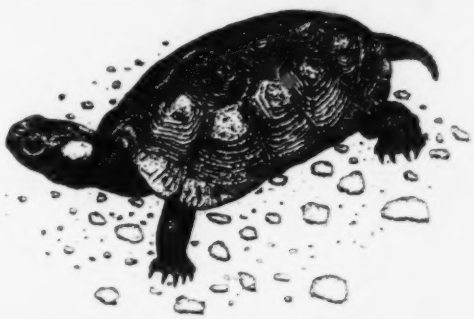
An **endemic** fish found in gravel **riffles** of creeks and tributaries of the upper New River. Notice the forked tail fin and large eyes. The Kanawha minnow is a food source for larger game fish of the New River.



Status: Special Concern in North Carolina and the United States.

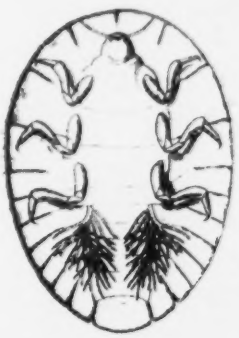
Virginia Spirea
(Spiraea virginiana)

A rare wildflower in North Carolina, this small shrub with pointed leaves has clusters of white or pink flowers for several weeks in June and July. It grows along steep sections of stream banks and is threatened by grazing animals, bank clearing, trampling, bank **erosion**, and competition from very fast growing, non-native plant species.
Status: Threatened in the United States; Endangered in North Carolina.



Bog Turtle *(Clemmys muhlenbergii)*

Measuring 3 - 3 1/2 inches in length, this water turtle is the smallest turtle in North Carolina. It is easily identified by its orange head patch. Although the bog turtle still inhabits the New River watershed, it is rare or completely absent in many regions where it was once fairly abundant. It lives in damp grassy fields, bogs and marshes. The fact that humans continue to drain these areas for cattle grazing and development has caused its decline.
Status: Threatened in the North Carolina mountains and piedmont.



Water Penny Beetle
(Family Psephenidae)

Often found attached to rocks, water pennies are flattened, round or oval-shaped, soft-bodied **larvae,** usually about as large as the end of your pinky finger (4 - 6 mm).

When water pennies reach adulthood, they become riffle beetles. These small, hard-bodied, crawling **aquatic** beetles live out of the water. They are often found on river banks or on rocks in the river (especially when laying eggs). Both adult and larvae feed on plants.
Status: Threatened in North Carolina.

Legend and Land Use Cutouts

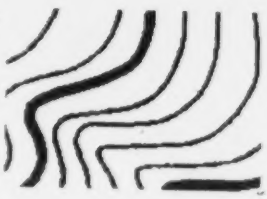
LEGEND FOR TOPO MAP

Building ■

Highway ▬▬▬

Dirt road – – – – –

Contour lines
(10 ft. intervals)



VACATION HOMES

VACATION HOMES

CATTLE FARM

GOLF COURSE

VACATION HOME SUBDIVISION

WASTEWATER TREATMENT PLANT

VEGETABLE FARM

FIRE STATION

SCHOOL

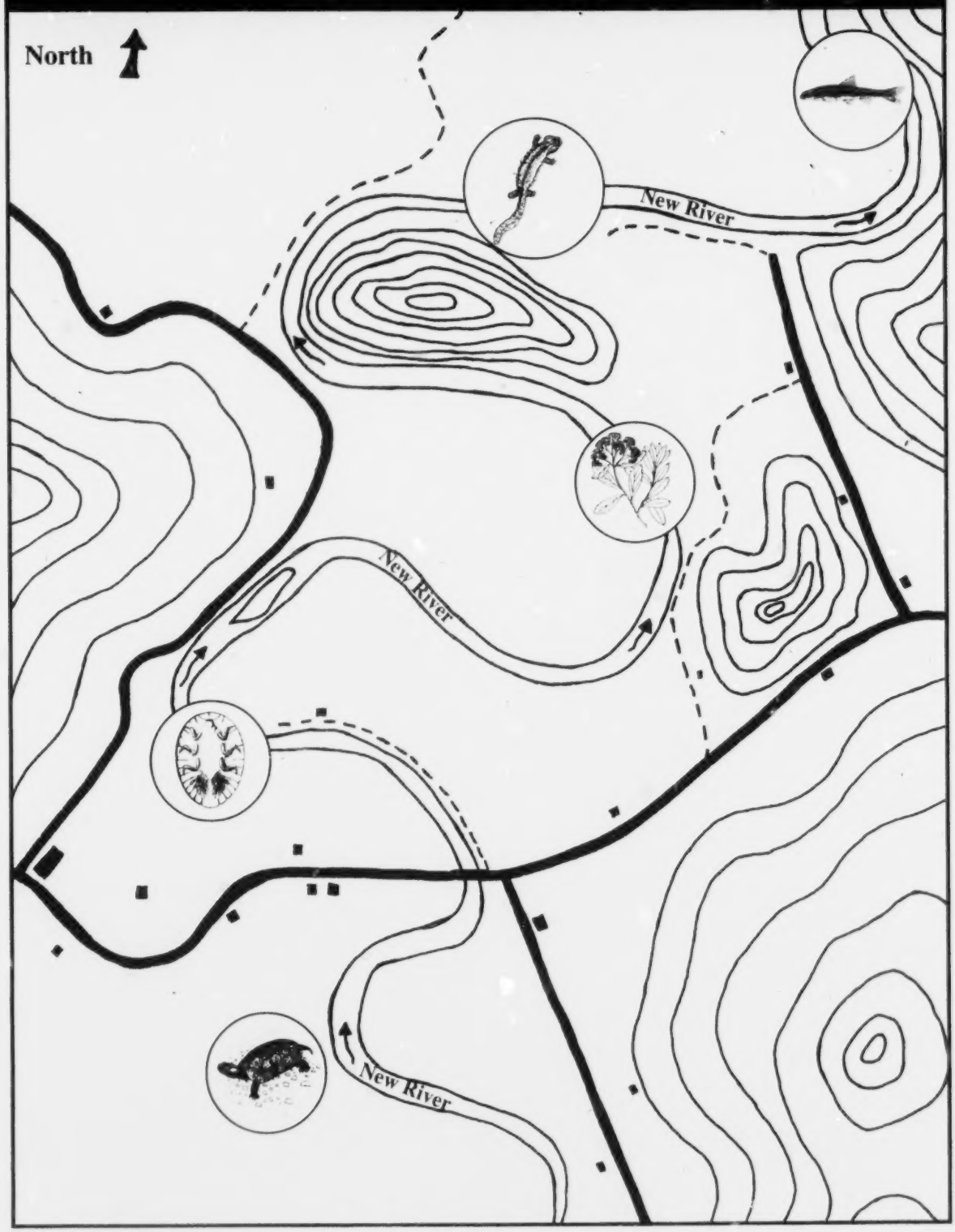
TEXTILE FACTORY

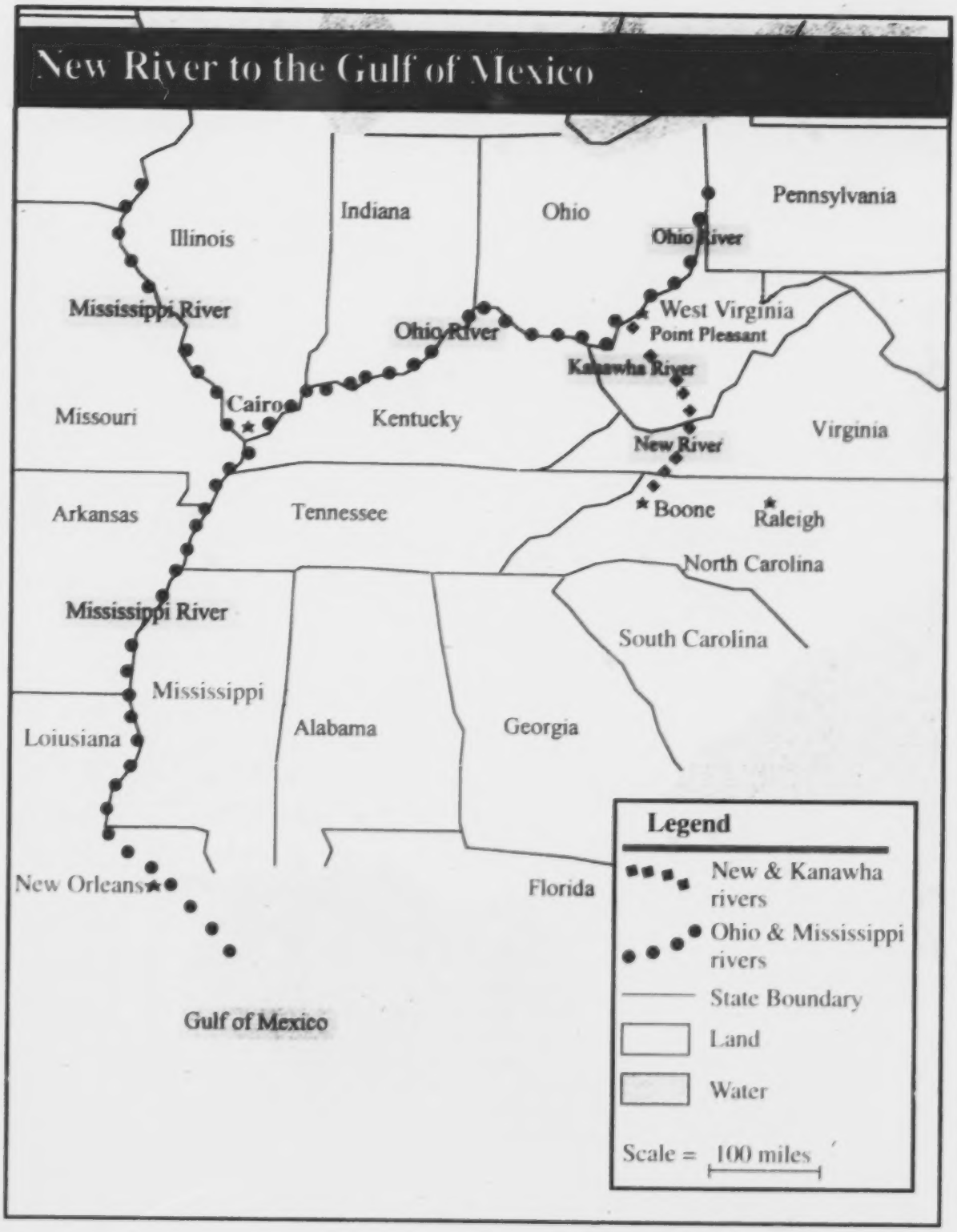
STATE PARK

LANDFILL

HOSPITAL

Topo Map of the South Fork of the New River




New River to the Gulf of Mexico
Illinois
Indiana
Ohio
Pennsylvania
Ohio River
Mississippi River
West Virginia
Point Pleasant
Ohio River
Kanawha River
Missouri
Cairo
Kentucky
Virginia
New River
Arkansas
Tennessee
Boone
Raleigh
North Carolina
Mississippi River
South Carolina
Mississippi
Loiusiana
Alabama
Georgia
New Orleans
Florida
Gulf of Mexico
Legend
New & Kanawha rivers
Ohio & Mississippi rivers
State Boundary
Land
Water
Scale = 100 miles

Post-Visit Activity 3 — Reality Check — Rural Development

Major Concepts:
- Environmental issues
- Water quality
- Land use planning
- River basin management
- Stewardship

Learning Skills:
- Observing, communicating, inferring, predicting
- Problem-solving, participating effectively in civic affairs
- Assessing the validity and accuracy of ideas

Subject Areas:
- Science
- Social Studies
- English Language Arts
- See **Activity Summary** for a Correlation with the DPI objectives in these subject areas.

Location: classroom

Group Size: 20 - 30 students

Time: Part I - one or two 45-minute periods; Part II - two or three class periods

Appropriate Season: any

Materials:
Provided by educator:
Per student: one copy of Student's Information and Issues Analysis Worksheet, pen or pencil
Per group: one copy of Find the Facts Worksheet and Meet the Players Worksheet

Objectives:

- Analyze a news article about a current land use issue in the New River Basin. Distinguish between facts and opinions, and make inferences regarding the beliefs and values of the individuals and groups interviewed by the reporter.
- Collect and organize facts and opinions about a current environmental issue by using interviews, surveys, questionnaires and opinionnaires.
- Work in groups to develop solutions to a current environmental issue. The solutions should be based on the facts the students have gathered and should represent a win-win approach for the major interest groups they have identified.

Educator's Information:

This activity gives students the opportunity to study land use issues in the New **River Basin**. In Part I, the students will analyze a 1995 news article about the subdivision development occurring near the state park. They will identify interest groups (stakeholders) and make inferences about the value positions held by these groups. In Part II, students are given an opportunity to gather and organize facts about a current environmental issue. The subdivision development is used as a model to illustrate teaching techniques. After doing their research, the students are invited to develop solutions to the issue that are based on known facts and are fair to all parties.

Instructions:
Part I - Issues Analysis

1. Photocopy the Student's Information and Issues Analysis Worksheet for each student. Pass out these handouts and explain: "Today we'll be studying an environmental issue in the New River Basin. You will read an actual news article that describes the subdivision development projects that were being planned and constructed along the New River near the state park in 1995. Your task will be to identify the individual players and interest groups that have a stake in this issue. When you identify a player, try to determine what that person believes about the development projects and what values may be important to him or her. Record your answers on the Issues Analysis Sheet. Notice that ten values are listed and described at the end of the Student's Information. Use these value terms when completing the 'possible values' section of the worksheet."

2. Do a guided practice using the examples given on the Issues Analysis Worksheet. Read aloud the first two paragraphs in the "New Currents" article, then show the students how the information should be organized on the worksheet. If the students are unfamiliar with values, read and discuss each of the ten value types given in the Student's Information. Tell the students that they should be able to find eight more players in the news article, in addition to Frank McCleneghan. However, two of the eight players are identified by a group name only (no spokesperson given). The educator should decide if students will work independently or in groups to complete the worksheet.

3. When most of the students have completed the worksheet, use the Answer Key in this activity as a guide to checking answers. Expect some deviations from the Answer Key; ask your students explain their reasoning.

4. Use the following as a discussion guide or ask students to write their answers:

A. The players interviewed for this article were a resident, several government officials, various environmentalists, the Chamber of Commerce, and a developer. Who else might have a stake in this issue? If you were a newspaper reporter, whom would you like to interview?

Answer: Accept a wide variety of answers here. Other stakeholders might be recreationists, tourists, politicians, real estate agents, local school officials, businessmen, policemen, farmers, senior citizens, etc.

B. Did all the environmental groups have the same beliefs and values?

Answer: No, the spokesman for the Committee to Save the New River seemed to indicate that development was compatible with his desire to "save the river." However, other environmentalists were convinced that development would harm the river. If the Committee to Save the New River is composed mostly of local citizens, they may be more interested in economic values than environmentalists who do not live in the river basin. Further interviews are necessary to better understand the value positions of these groups.

C. Did the developer and the Chamber of Commerce agree?

Answer: Although both the developer and the Chamber are interested in

economic values, they did not agree that the development projects would improve the local economy. The developer thought that bringing in more tourists and building more summer homes would not adversely affect other activities in the **watershed**. The Chamber had mixed feelings, believing that too many homes would spoil the beauty and possibly diminish the tourist trade.

D. Fact or Opinion? Ask students to skim the article again to locate "just the facts" about the development projects and their impact on the river. List facts on the chalkboard and/or ask students to underline or highlight facts on their copies of the Student's Information.

Answer: Most of the facts given in the article focus on the number and sizes of subdivision projects, the costs/values of land parcels, and how many lots have been sold to date. Most of the information given about potential impacts is speculation or opinion. However, one sentence indicates that facts or data might be available: "The river has since suffered from insufficiently treated sewage from municipal systems, **sediment** from golf courses and logging operations, and a variety of other problems." Perhaps at the time the article was written the actual data was not available to the reporter as he does not cite it here.

E. What types of studies could be done to gather facts about the potential impacts of development in the river basin?

Answer: Water quality studies could be conducted downstream from areas where development projects are already underway. These areas could be compared with other parts of the river that have no development. Research could also be done to find case studies where development projects were allowed in river basins similar to the New River. In addition, a sample of tourists and recreationists could be surveyed using questionnaires or opinionnaires to determine how tourism might be impacted by the subdivision projects.

F. Why is it important to get all the pertinent facts about an environmental issue?

Answer: In order to create a reasonable solution to an environmental issue, we need facts to help us define the problem. The newspaper article has alerted us to a possible problem but did not supply us with many facts related to the scope of the problem. How much will the water quality be impacted by development? Will the development be done in an environmentally-sensitive way? How much development can occur in a watershed before the water quality is unacceptable? Without more information, any solution we create will be meaningless.

G. Why is it important to understand the positions of the major players or interest groups before we try to create solutions to an environmental issue?

Answer: Environmental issues are usually complex and require everyone's cooperation if we are to successfully deal with them. We need to consider everyone's ideas so that our final solution will be as fair

as possible to all the players. Of course, there are laws that can be used to force people to act in responsible ways. However, it is usually better to seek a win-win solution first — one that all parties can commit to.

H. Other than the obvious environmental issue, what other issue(s) does the reporter imply in his article?

Answer: A diversity issue — the major developer in the area is marketing his lots to Cuban-Americans whose primary language is Spanish. Most of the residents and tourists currently in the New River Basin are Caucasians who speak only English. There are obvious cultural differences that may cause misunderstandings or difficulties in communication. Another issue (implied) is that of outsiders (Florida developers) destroying the natural resources of our state for their own profit. This is hinted at in the subtitle of the article, "Developers from Florida are turning farms along Alleghany's legendary river into a maze of resort homes."

I. Do you think the news reporter gave us a balanced treatment of the issue? Is there any bias toward one side or the other?

Answer: Most of the people interviewed in the article were opposed to the development. The reporter is primarily concerned about the river — ecological values are emphasized.

Part II - Generating Solutions

1. The "New Currents" article alerted us to a major environmental issue in the New River Basin. Whether your class is interested in generating solutions for a land use issue in the New River Basin, or some other environmental issue, the first step is to gather more facts and define the scope of the problem. This could be done in several ways. One approach is to invite individuals who are knowledgeable about the issue to visit your school and be interviewed by your students. If this is done, you should screen the list of interview questions and give the resource person a copy of the questions in advance. Another approach is to have students mail out questionnaires or letters requesting specific facts from the appropriate government officials and/or scientists. You could divide the students into teams and assign each team specific questions to answer or facts to research. A list of agencies or contacts for the New River Basin is given in this activity. Of course, each team should receive a copy of the information that the other teams have collected and compiled. If facts from different experts appear to disagree, try to find out why.

2. Next, it's time to learn more about the major players or stakeholders in the issue. In some cases, the individuals providing facts may also be able to give opinions or speak for a particular interest group. However, it is usually more helpful to find the facts first before interviewing interest groups regarding their beliefs, values and position on the issue. (In an attempt to persuade other people that their position is the correct one, some groups may distort the facts or present only those facts that support their argument.) The Meet the Players Worksheet in this activity will help your students get started on a New River land use issue. Again, resource people are listed in this activity. Call the park for updates on contacts for citizens groups and nongovernmental stakeholders. Whether students do face-to-face interviews or receive information via opinionnaires sent in the mail, all information collected should be shared with the other teams.

3. Give each team a class period to review the information collected and create a reasonable and fair

solution to the issue. You and your students may want to develop criteria that define "reasonable and fair solution." Some ideas are that it should be based on all the pertinent facts, every group should "win" something, and the solution should consider long term effects. Each team should present its solution to the class; discuss which solutions are most likely to work and why. You could also generate a class solution that incorporates the best ideas from all the team reports. Send a copy of your class solution to the appropriate state and local officials.

Assessment:

1. Use a current news article about an environmental issue in your county or region. Ask students to find the players and write inferences regarding their beliefs and values. What facts are given in the article? Is there an obvious bias?

2. Ask students to write an essay giving their arguments pro or con about the subdivision development projects. They should also describe a solution and explain why they support it.

3. Give students an assignment to collect facts and determine positions of interest groups regarding an environmental issue of their choice.

Extention:

Discuss types of actions that students can take to help resolve the subdivision issue or other environmental issue of importance to the students. If possible, choose a responsible action and carry it out as a class or as individuals. Evaluate the outcome of your actions.

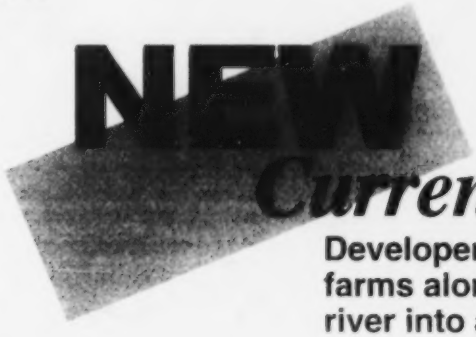
To order a copy of the *New River Basinwide Water Quality Management Plan*, contact the NC Division of Water Quality, P.O. Box 29535, Raleigh, NC 27626, (919)733-5083 ext. 360

List of Contacts:

For questions about ...	Contact:
Water Quality Data available on the New River Basin	NC Division of Water Quality, (919) 733-5083, ext. 573; US EPA-Office of Water, www.epa.gov/surf/IWI/0505001/index.html
Endemic or listed species in the New River Basin; wildlife habitat improvement programs	NC Natural Heritage Program, (919) 733-4181; NC Wildlife Resource Commission (919) 733-7123; NC Nature Conservancy, (919) 967-5493.
Building permit requirements	Alleghany Co. Building Inspector, (336) 372-8974; Ashe Co. Building Inspector (336) 246-1855.
Sewage treatment & water supply	Alleghany Co. Health Department, (336) 372-5641; Ashe Co. Health Department, (336) 246-9449; Ashe Co. Sanitarian (336) 246-9449; Alleghany Co. Sanitarian, (336) 372-8831; Jefferson Raw Water Plant, (336) 982-2828
Erosion control requirements	NC Division of Land Resources, (919) 733-4574; US EPA-Office of Water, www.epa.gov/surf/IWI/0505001/index.html
Environmental Impact Statements	NC Dept. of Administration, State Clearinghouse, (919) 733-7232;
Acreage of developments	Alleghany Co. Register of Deeds, (336) 372-4342; Ashe Co. Register of Deeds, (336) 246-1841
Maps of subdivisions	Ashe Co. Mapping Office, (336) 246-1836; Alleghany Co. Mapping Office, (336) 372-8291
Future shopping centers; vegetative buffers	Ashe Co. Planning Office, (336) 246-1830; Alleghany Co. Planning Office, (336) 372-5473
Road improvement plans	NC Dept. of Transportation (336) 667-9110 or (336) 667-9117
Flood plains	Alleghany Co. Natural Resource Conservation Service, (336) 246-5461; Ashe Co. Natural Resource Conservation Service, (336) 372-4645

Student's Information

NOTE: This is a reprint of an actual news article that appeared in the Winston-Salem Journal, Sunday, February 5, 1995



Developers from Florida are turning farms along Alleghany's legendary river into a maze of resort homes

By Vincent Morris
JOURNAL NORTHWEST BUREAU

PINEY CREEK — After a recent walk with his beagle pup, Frank McCleneghan stopped to savor the sight of the sun rising from behind a ridge along the New River.

"I tell ya, the combination of the river and the flood plain and the trees ... it's beautiful," says McCleneghan, a retired stockbroker from Winston-Salem.

But the scenery is changing.

Such developers as Elias Legra, a Florida citizen born in Cuba, are turning more and more farms into subdivisions. Legra, who made a living buying and selling real estate in Miami, is the biggest of a handful of developers who envision the mountains of Alleghany County as North Carolina's next resort area.

"In Miami, there is traffic, crime and stress, but not here," says Legra, who recently started selling lots for Two River Country, his second major project along the river.

Legra says he has sold about 14 lots at Two River Country, a 942-acre development near the confluence of the North and South forks of the New River that adjoins New River State Park property. His previous project, on the other side of the river, spanned more than 500 acres and bordered the Virginia state line. He says that most of the more than 300 home sites in the development, called River Country, are sold. So far, however, houses have been built on only a small number of lots.

State officials and environmentalists say that Legra's developments and others like them threaten to alter the New River in far-reaching ways. They say that the rural, pastoral character of the New will be lost if houses sprout up like so many mushrooms.

Jay Wild, a longtime park ranger, said people don't realize all the forces that are intruding on the river. "People take it for granted that the river is OK. It's not," said Wild from the park office in Ashe County near the small mountain community of Wagoner.

Fears about the river's future are not new.

In 1962, Appalachian Power Co. proposed a hydroelectric dam that would have flooded 40,000 acres. It was bitterly opposed. After a 14-year fight, 26.5 miles of the river that flow through the hills where Northwest North Carolina meets Virginia were designated as part of the National Wild and Scenic Rivers system.

Land was set aside for a state park along the river's banks, but little else was done to specifically protect it, says James H. Coman III, the executive director of the National Committee for the New River. The river has since suffered from insufficiently treated sewage from municipal systems, sediment from golf courses and logging operations, and a variety of other problems. Alan R. Clark, the coordinator of a basinwide study of the river being conducted by the N.C. Department of Environment, Health and

Student's Information continued

Natural Resources, said that development and similar sources of pollution worry him more than sewage-treatment plants or factories.

"It's sort of a low-grade type of problem that builds up over time. That's the scary part," he said. Last summer, construction at Legra's River Country and Two River Country accelerated. Alleghany building inspectors visited the river developments weekly. The register of deeds said that five to 10 home sites a week were being sold. Trees were cut down, and new graveled roads were blazed. Fresh subdivisions with such names as River Highlands, River Paradise and River Escape went on the books.

State park rangers and preservationists are alarmed that some of the subdivisions are going up near the visual corridor that defines the outline of New River State Park. Dozens of developments on the banks and nearby hills are planned or under way.

Other Florida developers in Alleghany own large tracts. Pedro Hernandez's 61 parcels are valued at more than $300,000; and Jose Cadi and Rene Carrasco's Raven Holdings Inc. owns more than 90 parcels worth more than $1 million. Hernandez, Cadi, Carrasco and other developers with interests in the New River section of Alleghany could not be reached for comment.

County tax records show that nearly 200 parcels of land are owned either by Legra and his wife or by one of several corporations he owns, Legra Land Investors Inc. being the largest. Though the appraised value is listed at $1.2 million, the actual value is much higher as lots are sold individually, say officials. Legra's lots have sold for as much as $16,000 for a half-acre.

All of the development has put Edmund Adams — the president of the Committee to Save the New for the past few years — in an odd situation. Adams, a lawyer in Sparta, does most of the legal work, such as title searches, for Legra. He said recently that he doesn't think his work helping Floridians develop land around the river compromises his work on the committee.

Legra has maintained that his plans will not harm the river. He said that he has heard virtually no opposition to any of his developments and that what little there is is based on jealousy. "We have brought a lot of tourists here. People who didn't know this county existed now own property here," he said. As for concerns that the homes he builds will affect the river, Legra dismisses them. "I guide everything that is built. We don't want to change this area," he said.

Legra has done his own promoting. Besides taking out Spanish-language advertisements in Florida, he invited a busload of guests to view his lots for themselves last fall.

A chartered bus brought the guests from the Piedmont Triad International Airport to Alleghany. After chugging up the road past cows and ramshackle barns to Legra's property, the bus stopped, disgorging a party of Cuban-Americans. The gate to the development is ringed with Latin and South American flags, though Legra says it is not intended only for Hispanic buyers. He showed the group model homes and available lots.

Patrick Woodie, the executive director of the Alleghany County Chamber of Commerce, says that the Legra project puts the county in an awkward position. Though he and others agree that tourism is important to the local economy, they worry about its size. Woodie says that too many "getaway" homes could spoil the region's pristine quality. Alleghany, he notes, calls itself "the unspoiled province." He wonders how many people will want to visit the river if houses line both sides of it.

end of article

Student's Information continued

Value Descriptions:

- **Ethical:** present and future responsibilities toward the environment and things in the environment
- **Moral:** "should" and "should nots" regarding how humans treat fellow humans
- **Political:** the activities, functions, and policies of governments and their agents
- **Economic:** the use and exchange of money and materials
- **Religious:** belief systems which are based on faith
- **Educational:** understanding how natural systems operate
- **Aesthetic:** appreciation of the environment through the senses
- **Recreational:** use the of environment for leisure activity
- **Ecological:** maintenance of the health of natural systems (includes ideas of balance, stability, integrity and diversity)
- **Health:** maintenance of positive human physiological conditions in relation to the environment

Issue Analysis Worksheet

Player's Name	Interest Group Represented	Belief/ Statement	Possible Values:
Example: Frank McCleneghan	Resident (retired citizen)	• Scenery is beautiful • Walks dog here	Aesthetic Recreational
"State officials and environmentalists"			
"Park Rangers & Preservationists"			

Issue Analysis Worksheet— Answer Sheet

Player's Name	Interest Group Represented	Belief/ Statement	Possible Values:
Example: Frank McCleneghan	Resident (retired citizen)	• Scenery is beautiful • Walks dog here	Aesthetic Recreational
Elias Legra	Developer	• No traffic, crime, stress here • Bring lots of tourists • Won't change area — will guide development	Health Economic Ethical/ Ecological
"State officials and environmentalists"		• Pastoral character will be lost	Aesthetic Political
Jay Wild	Park Ranger (state official)	• River is not OK • Fear for future	Ecological & possibly Ethical
James Coman III	National Comm. for New River (environmentalist?)	• Little has been done to protect the river from sewage, sediment and other problems	Ecological & possibly Ethical
Alan R. Clark	State Official w/ DENR	• Low-grade problems build up over time	Ecological Ethical Political
"Park Rangers & Preservationists"		• Visual corridor is being affected	Aesthetic (Recreational?)
Edmund Adams	Committee to Save the New (environmentalists?)	(inferred only) • it is possible to develop the area & "save" the New River at the same time	Economic & Ecological
Patrick Woodie	Alleghany Chamber of Commerce	• Tourism is important • But too many homes spoil pristine quality • Who will want to visit?	Economic Aesthetic/ Ecological Economic/ Recreational

Find the Facts Workheet

The "New Currents" article in the Student's Information gives some facts regarding the subdivision projects underway along the New River and the impacts on the environment. Briefly note major facts here:

_____

_____

_____

_____

_____

Many facts that can help us define the scope of the problem are missing. Asking the right questions could help us find out more. Look at the questions below. Write a few of your own and think about who could give you the answers.

1. How many acres of land have been developed since 1995 when the article was written?
2. Where are the subdivisions located? Are there maps available that show the subdivisions?
3. Have Environmental Impact Statements been filed on any of the developments? Are they required for these projects?
4. How have current subdivisions affected the **water quality?** Is data available on pH, turbidity, **dissolved oxygen**, or other characteristics?
5. Are any of the subdivisions located within the 100-year flood level?
6. What techniques are being used to control **erosion** during construction of homes and roads?
7. Is a vegetated buffer required between house lots and the streams or the river?
8. Where will homeowners get their water? How will this impact the flow of the river?
9. What types of wastewater treatment are being used — individual septic systems, treatment plants for each subdivision, or other methods? Where will the treated water enter the river?
10. Where will stormwater runoff go? Are there ditches, drains or sewers leading into the river?
11. Are there any listed **species** (endangered, threatened or special concern) in or near the subdivision area?
12. What is being done to protect wildlife **habitats**?
13. Are any improvements being planned for the curvy mountain roads leading into the subdivision in order to accommodate increased traffic?
14. Are there any plans for new stores or shopping centers to serve all the new residents?

1.0

Meet the Players Worksheet

Now that we have some facts, let's meet the players in the subdivision issue. Which interest groups do you think are the major players who will take an important role in carrying out the solution to this issue? List them here:

_____ _____

_____ _____

_____ _____

_____ _____

Next, develop questions you would like to ask each group to learn more about their position on the issue and their beliefs and values. Consider the questions below and write some of your own. You may have to give the players a brief summary of the issue before conducting your interview or before asking them to complete a written opinionnaire.

1. What group do you represent? How many members do you have and what are the goals of your organization?

2. Is your group for or against the subdivision development along the New River? Why?

3. What are your group's goals or dreams as far as the New River is concerned?

4. What solution to this land use issue seems fair and reasonable to you?

5. What is your group's primary concern — what one thing is vital — that you would not be willing to give up when trying to solve this issue?

6. What would your advice be to citizens wanting to take action for or against the development?

7. What do you think the New **River Basin** will look like ten years from now?

8. Overall, do you think the subdivisions will be good or bad for the local economy? Why?

9. Overall, do you think the subdivisions will be good or bad for water quality and wildlife habitats? Why?

10. How have current projects impacted water quality? Is there data available on this?

11. Are the roads in the new developments gravel or paved? Who will maintain them?

12. What techniques will be used to control runoff from the roads going into the river?

13. Are there any endangered species on the land that is being developed?

Meet the Players Worksheet continued

14. What is being done to protect wildlife habitat in the developments and in the river adjoining the subdivisions?

15. What will happen to the sewage created by all the new homeowners?

16. Where will the homeowners get their water? Will it affect the river?

17. Have environmental impact statements been done — are they required?

18. How will the subdivisions affect the local store owners? Are there any plans for new stores or shopping centers?

19. Will the roads be safe for hikers, cyclists and children? Are there any improvements being considered for the curvy mountain roads that lead into the developments?

20. Will people be allowed to use pesticides and fertilizers on their new lawns? Is a vegetative buffer required between house lots and streams or the river?

21. Are any of the developments located within the 100-year flood level?

VOCABULARY

Adaptation - A change in the structure or activity of an organism that produces a better adjustment to its environment, thus enhancing its ability to survive and reproduce. For example, the flattened, oval shape of the larva of the riffle beetle (called a water penny) is an adaptation that helps it cling to the surface of rocks in swift waters.

Algae - Simple, one-celled or many-celled plants capable of photosynthesis. They are usually aquatic and have no true root, stem or leaf.

Anatomy - The branch of biology that deals with the structure of living organisms.

Aquatic - Living or growing in water.

Atmospheric deposition - Particles from the atmosphere deposited on the earth's surface in either wet or dry form.

Biology - The science that deals with the origin, history, physical characteristics, life processes and habits of living organisms.

Biotic index - Serves as an indicator of the health of a habitat. It is based on the tolerance or sensitivity of plants and animals to changes in environmental quality and is calculated using a simple formula. For example, the health of a stream is determined by the number of individual organisms plus the diversity of species found there.

Classification - The grouping of organisms into categories based on shared characteristics or traits. For example, any animal that has feathers is considered a bird and is placed in the class Aves. Furthermore, if the bird has its eyes in front rather than on the side of its head, it is a member of the order Strigiformes (the owls).

Community - A group of organisms living in a specific region under similar conditions, and interacting with each other through food webs and other relationships.

Concerns - Matters that relate to or affect someone or something.

Contour lines - The imaginary lines, or their representation on a contour map, joining points of equal elevation.

Decomposer - An organism whose feeding action results in decay, rotting or decomposition. The primary decomposers are bacteria and fungi. They are very important parts of a healthy ecosystem.

Decomposition - To rot or to break apart into basic components. Decomposition makes nutrients, such as nitrogen and phosphorus, available for use by other organisms.

Delta - A usually triangular, alluvial deposit at the mouth of a river.

Detritus - Dead organic matter, such as fallen leaves, twigs and other plant and animal material, which exists in any ecosystem.

Dichotomous - Divided into two parts, groups or classes, such as a dichotomous key. Using a dichotomous key, one can identify an unknown organism by following the one branch of each pair that best describes the organism.

Distribution - The act of scattering or spreading out; the geographic range of an organism.

Dissolved oxygen (DO) - The amount of oxygen gas molecules dissolved in water. Fish and other aquatic animals depend on DO for respiration.

Diversity - In the context of these activities, diversity refers to the variety (or number of different kinds) of species of plants and animals.

Ecology - The science of the relationships between organisms and their environments.

Ecosystem - Living organisms and their physical surroundings which interact with environmental conditions, such as temperature and rainfall, forming an interdependent system.

Endemic - Confined or peculiar to a particular locality.

Erosion - The wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is removed from the earth's surface.

Estuary - The part of the wide lower course of a river where its current is met and influenced by the tides.

Food chain - The transfer of energy and material through a series of organisms as each one is fed upon by the next. For example: detritus >> caddisfly larvae >> sunfish >> otter.

Food web - The interlocking pattern of food chains which exist in an ecosystem.

Genus - In biology, a taxonomic category ranking below a family and above a species, used in grouping similar living things, either alone or followed by a Latin adjective or epithet, to form the name of an organism. It is the main subdivision of a family. For example all hickories belong to the genus Carya.

Groundwater - Water that seeps into the earth and is stored in usable amounts in the soil and rock below the earth's surface; water within the zone of saturation.

Habitat - The environmental conditions of an area where an organism naturally grows or lives; its environment.

Healthy - In the context of these activities, it refers to the cleanliness or purity of the stream water.

Indicator species - An organism whose presence or absence in a particular environment can be used to determine the health of that particular environment.

Insect - Any animal in the class Insecta, having a head, thorax, abdomen, and three pairs of legs on the thorax. Adults usually have one or two pairs of wings attached to the thorax as well.

Key - In the context of these activities, a key is an ordered list of significant characteristics of a group of organisms and is used to identify unknown species.

Larva (larvae, plural) - The immature form of an animal that changes structurally when it becomes an adult, usually by complete metamorphosis.

Leachate - The syrupy liquid formed when water (from precipitation) infiltrates the soil covering a landfill and percolates down through the waste, picking up a variety of suspended and dissolved materials from the decomposing waste.

Macroinvertebrate - An invertebrate usually large enough to be seen without the aid of magnification. From *macro* (large) and *invertebrate* (without a backbone).

Meanders - The winding and turning course of a stream or river.

Metamorphosis - A change in form, structure or function as a result of development. A physical transformation undergone by various animals during development from the larval stage to the adult form. For example, through metamorphosis, a hellgrammite (larval form) becomes a dobsonfly (adult form). The change from a tadpole (larval form) to a frog (adult form) is another example of metamorphosis. From *meta* (change) and *morphe* (form).

Morphology - The biological study of the form and structure of living organisms.

Mussel - Any of various freshwater or saltwater bivalves (meaning the two shells are held together by a strong muscle).

Native - An organism originally found in a certain area; not foreign.

Nonpoint source pollution - Pollution that cannot be traced to a specific point because it comes from many individual places or a widespread area (e.g., urban and agricultural runoff).

Nymph - The young of an insect that undergoes incomplete metamorphosis, differing from the adult primarily in size and structural proportions (i.e. wings).

Organism - A living thing. Examples include plants, animals, bacteria, virus and fungi.

Osprey - A fish-eating hawk, having plumage that is dark on its back and white underneath.

Outstanding resource water - A legal designation given to very pure, unpolluted stream water.

Photosynthesis - The chemical process carried on by green plants in which the cells that contain chlorophyll use light energy to produce glucose (a plant food) from carbon dioxide and water; oxygen is released as a by-product. See: Respiration.

Physiology - The biological science of essential and characteristic life processes, activities and functions; all the vital processes of an organism.

Plankton - Collective term for the mostly microscopic plants (phytoplankton) and animals (zooplankton) that float or drift in oceans and fresh waters. These plants and animals are very important food sources in aquatic environments.

Point source pollution - Pollution that can be traced to a single point source, such as a pipe or culvert (e.g., industrial and wastewater treatment plant discharges).

Pollution - A human-caused change in the physical, chemical or biological conditions of the environment that creates an undesirable effect on living things.

Pool - A deep, still spot in a river, creek or stream.

Precipitation - A general term for all forms of falling moisture including rain, snow, hail and sleet.

Predator - An animal that captures, kills and feeds on another animal.

Respiration - The process by which an organism takes in oxygen and releases carbon dioxide; breathing. See: Photosynthesis.

Riffle - A shoal or a gravel bar in a shallow part of a stream that produces a stretch of choppy, ruffled water surface. This area has a higher dissolved oxygen level than a stream's pool areas.

Riparian - Pertaining to a bank of a river, pond or lake.

River basin - The total land area that contributes runoff to a particular river.

Sediment - Deposits of soil or organic matter which were suspended in water and then settled to the bottom. It is often deposited in the water by runoff.

Silt - A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Snail - An aquatic or terrestrial mollusk having a spiral shell, a broad retractile foot, and a distinct head.

Soil - A collection of organic and inorganic particles, mainly composed of clay, slit, sand and gravel.

clay - less than 1/256 of a millimeter (mm) in diameter
silt - between 1/256 and 1/16 of a mm in diameter
sand - between 1/16 and 2 mm in diameter
gravel - over 2 mm in diameter

Species - The taxonomic category located after genus which consists of organisms that have a high degree of similarity and can mate and produce fertile offspring.

Stewardship - The act of people taking responsibility for the protection and preservation of a clean and healthy environment.

Succession - The gradual replacement of one community by another.

Taxonomy - A branch of biology dealing with arranging and classifying organisms into natural, related groups based on some factor common to each, such as structure, embryology, biochemistry, etc.

Topographic - The representation of surface features of a region on maps or charts.

Tributary - A stream or river flowing into a larger stream, river or lake. The New River and the Gauley River are tributaries of the Kanawha River.

Volume - A quantity, bulk, mass or amount; the amount of space occupied in three dimensions.

Water - A transparent, odorless, tasteless liquid compound of hydrogen and oxygen (H_2O) which occurs on the earth's surface as oceans, lakes, rivers, etc.

Water pollution - Any human-caused contamination of water that reduces its usefulness to humans and other organisms.

Water quality - The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Watershed - All of the land area that drains directly or indirectly into a creek, river, lake or other body of water.

References

Amos William H. 1969. "Limnology." For more information contact the LaMotte Chemical Products Company, Education Products Division, P. O. Box 329, Chestertown, MD 21620.

Balcom, Nancy C. (ed.). 1991. "Mainstream," "Habitat Hunt," "Where the Water Falls" and "Little Limnologists" activities. *Virginia's State Parks: Your Backyard Classroom*, Chesapeake edition. For information contact the Virginia Department of Conservation and Recreation, Division of State Parks, 203 Governor St., Suite 306, Richmond, VA 23219.

Borror, Donald J. and Richard E. White. 1990. *A Field Guide to Insects of America North of Mexico.* Boston, MA: Houghton Mifflin Co.

Brown, Walker R., and Norman D. Anderson. 1971. *Earth Science — A Search for Understanding.* Philadelphia, PA: Lippencott Co.

Caduto, Michael J. 1985. *Pond and Brook, A Guide to Nature Study in Freshwater Environments.* Englewood Cliff, NJ: Prentice Hall, Inc.

Council for Environmental Education Council. 1987, 1992. *Project WILD Aquatic Education Activity Guide.* For information contact NC Wildlife Resources Commission, 512 North Salisbury St., Raleigh, NC 27604-1188.

Dean, Jim. 1978. "The Year the Floods Came," *Wildlife in North Carolina*, February. For more information contact NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Earley, Lawrence. 1990. "Taking a River's Pulse," *Wildlife in North Carolina.* August. For more information contact NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Everhart, Jerry (project director). 1986. *Project MOST.* For more information contact Pitt County Schools, 1717 West 5th St., Greenville, NC 27834.

Headstrom Richard. 1964. *Adventures with Freshwater Animals.* Mineola, NY: Dover Publications.

Izaak Walton League of America. "Save Our Streams." For more information contact the Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington ,VA 22209.

McCafferty, Patrick W. 1981. *Aquatic Entomology, The Fisherman's and Ecologist's Illustrated Guide to Insects and Their Relatives.* Illustrations by Arwin V. Provonsha. Boston, MA: Jones and Bartlett Inc.

McLane, A.J. 1965. *McClanes' Standard Fishing Encyclopedia and International Angling Guide.* Austin TX: Holt Rinehart and Winston Inc.

Menhinick, Edward F. 1991. *The Freshwater Fishes of North Carolina.* North Carolina Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Mitchell, Mark and William Stapp. 1990. *Field Manual for Water Quality Monitoring. An Environmental Education Program for Schools.* Dexter, MI: Thomson-Shore Printers.

Montgomery County Public Schools. 1972. "Activities for Studying Streams," *Environmental Education Series*, Bulletin No. 247 A. For more information contact Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 28050.

Montgomery County Public Schools. 1972. "Activities for Studying Ponds," *Environmental Education Series*, Bulletin No. 247 D. For more information contact Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 28050.

National Aquarium in Baltimore. 1987. "In Hot Water?" *Living in Water: Aquatic Science Curriculum for Grades 4-6.* For more information contact the National Aquarium in Baltimore, 501 E. Pratt Street, Pier 3, Baltimore, MD 21202.

National Wildlife Federation. 1983. *Acid Rain — A Teacher's Guide.* For more information contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

National Wildlife Federation. 1987. "We Care About Clean Air," *National Wildlife Week Educators Guide*, March 15-21. For more information contact the National Wildlife Federation, 1400 16th St., N.W. Washington, DC 20036-2266.

National Wildlife Federation. 1990. "Pollution: Problems and Solutions," *Ranger Rick's NatureScope.* For more information contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

National Wildlife Federation. 1990. "Earth Day Every Day — You Can Make a Difference," *Educator's Guide.* For more information contact the National Wildlife Federation, 1400 16th St., NW, Washington, DC 20036.

Needham, James and Paul Needham. 1962. *A Guide to The Study of Freshwater Biology.* Oakland, CA: Holden-Day Inc.

North Carolina Division of Parks and Recreation. 1993. *Duke Power State Park Environmental Education Learning Experience.* For More information contact Duke Power State Park, 159 Inland Sea Lane, Troutman, NC 28166-9620.

North Carolina Division of Environmental Management, Water Quality Section. 1995. *New River Basinwide Water Quality Management Plan.* For more information contact NC Division of Water Quality, Water Quality Section, PO Box 29535, Raleigh, NC 27626-5083.

North Carolina Division of Parks and Recreation. 1993. *Eno River State Park Environmental Education Learning Experience.* For more information contact Eno River State Park, 6101 Cole Mill Road, Durham, NC 27705.

North Carolina Division of Water Resources. 1991. "pH — What Does It Mean?" *Streamwatch News*, Issue #13, Feb. For more information contact North Carolina Division of Water Resources, PO Box 27687, Raleigh, NC 27611.

North Carolina Division of Water Resources. 1991. "Sediment: It's Only Dirt, Right?" *Streamwatch News*, Issue #15, Nov. For more information contact North Carolina Division of Water Resources. PO Box 27687, Raleigh, NC 27611.

North Carolina Wildlife Resources Commission. Dec. 1989. "Josh and the Fish Kills," *North Carolina WILD Notebook.* For more information contact the Division of Conservation and Education, NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Page, Lawerence and Brooks M. Burr. 1991. *Freshwater Fishes.* Peterson Field Guide Series. Boston, MA: Houghton Mifflin Co.

Pfeiffer, C. Boyd and Mark Sosin. 1987. *Aquatic Resources Education Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Co.

Quammen, David. 1985. *Natural Acts, A Sidelong View of Science and Nature.* New York, NY: Nick Lyons Books.

Reid, K. George and Herbert Zim. 1967. *Golden Guide, Pond Life.* New York, NY: Golden Press Inc.

Schoenbaum, J. Thomas. 1979. *The New River Controversy.* Winston Salem, NC: John F. Blair, Pub.

Slattery, Britt E. 1991. "Wet'n'Wild," *WOW!: The Wonders of Wetlands: an Educator's Guide.* For more information contact Environmental Concern, Inc., P.O. Box P, St. Michaels, MD 21663-0480.

Swan, Malcolm D. 1983. *Tips and Tricks in Outdoor Education —Approaches to Providing Children with Educational Experiences in the Outdoors.* Danville, IL: The Interstate Printers & Publishers, Inc.

Taylor, Mark. 1989. *Streamwalking With Kids, An Outing Leader's Guide.* Reprinted by North Carolina Wildlife Resources Commission. For more information contact the North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Raleigh, NC 27604-1148.

Tennessee Valley Authority. 1993. *Environmental Resource Guide — Nonpoint Source Pollution Prevention.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/Energy Education Program, Knoxville, TN 37902.

Tennessee Valley Authority. 1986. *Groundwater: A Vital Resource, Student Activities.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/ Energy Education Program, Knoxville, TN 37902.

Tennessee Valley Authority. *Homemade Sampling Equipment.* For more information contact T.V.A., Office of Natural Resources and Economic Development,Environmental/ Energy Education Program, Knoxville, TN 37902.

Tennessee Valley Authority. *Water Sampling Equipment.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/ Energy Education Program, Knoxville, TN 37902.

Willoughby, L. G. 1976. *Freshwater Biology.* New York, NY: Pica Press.

Winborne, Ferne B. 1989. *A Guide to Streamwalking.* For more information contact the North Carolina Division of Water Resources, 512 North Salisbury Street, Raleigh, NC 27604-1148.

SCHEDULING WORKSHEET

For office use only:
Date request received_____ Request received by_____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones _____
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: New River State Park
P.O. Box 48
Jefferson, NC 28640

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at **New River State Park**. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful? _____
   _____

4. What can we do to improve the program(s)? _____
   _____
   _____

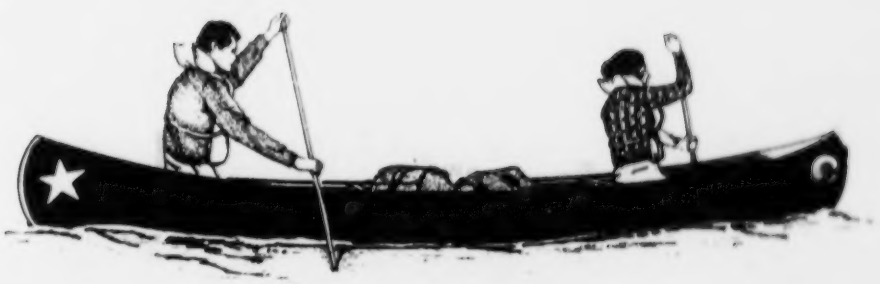
5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

New River State Park
P.O. Box 48
Jefferson, NC 28640

Notes